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ENLISTED SUPPLY: PAST, PRESENT, AND FUTURE

Executive Summary & Main Text

Lawrence Goldberg

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Enclosure (1) to CNO ltr ser 91/3U334958 dated 27 September 1983.

Naval Studies Group

CENTER FOR NAVAL ANALYSES

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Subj: Navy Enlistment Supply Study (NESS) Summary Report; promulgation of

Encl: (1) CNS 1168, "Enlisted Supply: Past, Present, and Future," Volume I September 1982.
(2) CNS 1168, "Enlisted Supply: Past, Present, and Future," Volume II September 1982

1. The Center for Naval Analyses was requested to examine ways of expanding the Navy manpower pool by estimating the effects on the available supply of manpower of Navy policy and recruiting resources. Specifically, the tasks were to reconcile disparities in previous studies of recruiter and advertising productivity; and estimate the affects of Navy enlistment goals and other federally imposed policies, such as minimum wage and CETA programs for youth.

2. With few exceptions, the study found that the supply of available manpower on which the Navy draws is significantly affected by military pay, GI Bill benefits, recruiters, advertising, unemployment, population and Department of Labor programs. The essence of these effects and their impact on Navy enlistment goals for recruiting in the 1980's is contained in enclosures (1) and (2). The NESS study has contributed to the Navy's understanding of these factors and the effective application of scarce resources to achieve our recruiting goals.

C. A. H. Trost

C. A. H. TROST
Vice Admiral, U. S. Navy
Director, Navy Program Planning

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ABSTRACT

There is concern about the ability of the armed forces to meet their accession requirements as youth population declines over the next 10-15 years. This study addresses this concern by developing a way to predict the supply of high quality accessions to all four services. Accessions are then projected for the rest of the decade under various assumptions.

Data organized by Navy Recruiting District for the period 1976-1981 are examined to relate the number of high quality accession contracts to economic and policy factors, as well as to the size of the youth population. The pay of civilian youth, military pay, recruiters, advertising, and economic conditions were key determinants of recruit supply. GI Bill benefits induced many accessions. Population was important, but not as important as many expected.

Projections indicate that (with minor exceptions) recruiting goals can be met through the 80s if current plans are executed. Over the longer run, goals can be met if military pay keeps up with civilian youth pay and if recruiting resources are made available quickly when the economy strengthens.

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EXECUTIVE SUMMARY

The last draft call in late 1972, preceded by a significant pay increase for enlisted recruits, signaled the beginning of the All-Volunteer Force (AVF) and the dependence on the labor market to satisfy the demand for enlistees. The draft induced many men to enlist, so manpower planners have been faced with the problems of attracting high quality enlisted volunteers to replace draftees and draft-motivated enlistees of the earlier era.

By and large the services were successful in 1973-77 in meeting total recruiting goals and attracting higher-quality enlistees; in FY 1978-79, however, there were enlistment shortfalls. Since 1980 recruiting has recovered and continued to improve. But supply fluctuations of recent times suggest the difficulty in managing military manpower and recruiting.

To carry out their management functions, the services need forecasts of enlistments and estimates of the cost and effects of policies that affect supply. To provide the required information, this study analyzes the supply of nonprior-service male high school graduate (HSG) enlistments to each of the military services.

For each service and DoD, we applied regression analysis to five years of annual data--from October 1975 to September 1980--on enlistment contracts in the Navy's 43 recruiting districts (for a total of 215 observations). An extensive effort was made to obtain accurate district level data on enlistment and supply factors. The study estimates the effect of management policies--military pay, GI Bill benefits, recruiters, and Navy advertising*--as well as exogenous factors and public programs--population, unemployment, training programs of the Department of Labor, and student-aid programs of the Department of Education. The results are used to evaluate manpower management policies and forecast supply for the FY 1981-87 period.

FINDINGS

With just a few exceptions, statistically significant effects were found for military pay, GI Bill benefits, recruiters, Navy advertising unemployment, population and Department of Labor programs. No effect of student-aid programs was found.

The results explain why there were serious recruiting problems in FY 1978-79. Shortfalls occurred primarily because of government policies: cuts in GI Bill benefits and caps on military pay; increases in Department of Labor programs further reduced enlistment supply, but

* Data on other services' advertising were not available.

only slightly. Between FY 1976T and FY 1978, these combined factors reduced the enlistment supply of mental group 1-3A HSGs by 53 percent for the Army and by about 33 percent for the other services.

A principal policy implication is that a GI Bill is the most expensive alternative for increasing supply compared to military pay, recruiters, or advertising. For example, for the Navy, the marginal cost would probably exceed $200,000 per 1-3A HSG; while the cost of using enlistment bonuses would be $29,400, the costs would be just $5,800 for recruiters and $1,600 for advertising. Recruiters and advertising are less expensive than GI Bill benefits or bonuses because they avoid making payments to those who would have joined anyway.

The findings also appear to refute some of the conventional wisdom regarding recruiters and population. In spite of evidence to the contrary, for years OSD argued that recruiters do not increase supply but simply distribute a fixed number of enlistments among the services. We have found that recruiters increase DoD enlistments and that they are a relatively cost-effective means of increasing supply. Declines in population in the 1980's will reduce enlistments, and some believe that decreases will be so serious that a return to the draft is inevitable. We found that recruiting problems caused by population declines should be far less serious than some are expecting. We believe that this is due to an often overlooked benefit of shrinking cohorts: recruiting resources will not be spread as thin as they are today.

FORECASTS

Forecasts were made of enlistment supply in the 1980's. Relative to FY 1980, DoD supply will increase by at least 15 percent in FY 1982-87. This is the case despite the decline in the military-eligible population. Supply will increase because of the increases in military pay and GI Bill benefits, and reductions in Department of Labor programs. Of course, if compensation and recruiting effort do not attain the levels used to make the projections, enlistments will suffer.

The forecasts were compared with requirements taken from the services' Program Objective Memorandums (POMs). The Navy, Air Force, and Marine Corps should be able to achieve their recruiting goals. The Army will likely achieve its enlistment goals if the "Ultra VEAP" program generates a 15-20 percent increase in Army enlistments.

CONCLUSIONS

Despite population declines, the services should be able to achieve their enlistment goals in the 1980's. However, fluctuations of the economy may cause short-run problems. The manpower and personnel system was too slow in responding to shortfalls caused by changes in the economy in FY 1978. In response to shortfalls in FY 1978, recruiters were not increased until FY 1980 and military pay was not increased until

FY 1981. For recruiting to be successful, military pay and benefits must keep up with those in the private sector on a year-to-year basis, and the services' recruiting commands need to be able to adjust more quickly to changes in the economy.

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INTRODUCTION

STUDY OBJECTIVE

Whether to meet shortfalls or respond to budget pressures, the services need forecasts of enlistment supply and estimates of the costs and effects of policies that can be used to increase enlistments. This study analyzes the cost-effectiveness of four types of policies--recruiters, advertising, military pay, and GI Bill benefits. This is accomplished by estimating the effects of economic factors, demographic factors, and recruiting resources on the supply of enlistments to the military services. Estimates are obtained using regression analysis with annual data at the Navy recruiting district level for the period October 1975-September 1980. The study also develops a forecasting model and uses it to predict enlistments in the 1980's.

HISTORICAL PERSPECTIVE

The military services achieved their enlistment goals in FY 1980 for the first time since FY 1976. Faced with shortfalls in FY 1978-79, the services responded by increasing recruiting resources, military pay and GI Bill benefits. Because of these policies and a downturn of the economy, recruiting improved dramatically in FY 1980-82. Indeed, improvements have been so spectacular that the services are currently under pressure to cut recruiting resources and limit the growth of military pay.

Changes in high school graduate (HSG) enlistment contracts from FY 1976T (October 1975-September 1980) to FY 1980 are shown in table 1. While total HSG contracts were fairly constant from FY 1976T to 1977, those for mental groups 1-3A HSGs and mental groups 1-2 HSGs declined sharply. All categories of HSGs declined in FY 1978-79 and then increased in FY 1980.

Changes in supply factors over the 1976-80 period are given in table 2. The study examines the impact of the reductions in the GI Bill benefits that occurred in 1977, the decline of military pay (relative to civilian earnings), and the movement of recruiter resources, as well as the role played by the improving and subsequently worsening civilian

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Note: When this work was undertaken, existing models of enlisted accessions were hampered by a lack of appropriate cross-section data, leading to consistently poor predictions. While this study is not the last word on the subject, it demonstrates that some of the problems of earlier research can be overcome. Both the Office of the Secretary of Defense and the individual services are sponsoring efforts to build on this work and further improve the ability to predict military accessions under a variety of circumstances.

TABLE 1

HIGH SCHOOL GRADUATE ENLISTMENT
CONTRACTS FY 1976T-80[a]

Service	All HSG (000)					1-3A HSG (000)				
	1976T	1977	1978	1979	1980	1976T	1977	1978	1979	1980
Navy	72.2	70.4	54.7	51.0	67.5	46.6	41.2	32.1	28.1	39.0
Army	96.4	91.2	74.9	69.6	74.0	44.9	34.3	25.6	23.0	26.6
Air Force	54.9	57.4	46.5	46.2	68.0	41.9	37.2	30.8	28.7	40.3
Marine Corps	29.2	29.9	26.9	24.4	31.9	17.5	14.6	12.1	10.4	14.5
DoD	252.7	248.9	203.0	191.2	241.4	150.9	127.3	100.6	90.2	120.4

Service	1-2 HSGs (000)				
	1976T	1977	1978	1979	1980
Navy	31.2	27.8	21.6	19.0	26.5
Army	29.1	21.8	15.8	14.0	17.2
Air Force	27.2	24.0	18.9	17.4	25.2
Marine Corps	11.0	9.0	7.3	6.2	9.0
DoD	98.5	82.6	63.6	56.6	77.9

[a]HSGs include about 6 percent GEDs. The data are normed to reflect 1981 mental group standards, and they account for attrition from the Delayed Entry Program.

TABLE 2

LEVELS OF SUPPLY FACTORS IN FY 1976T-80

Factors	1976T (Oct 75-Sep 76)	1977	1978	1979	1980
Relative military-civilian pay	1.23	1.20	1.10	1.07	1.07
Unemployment rate for all civilians	8.5	6.4	5.5	5.1	6.7
Employment and Training Administration youth programs ($ billions)[a]	1.9	2.1	2.4	2.3	2.4
Employment and Training Administration counter-cyclical programs ($ billions)[a]	2.7	2.7	5.3	4.0	2.8
GI Bill	yes	no	no	no	no
Total 17-21 male population (millions)	10.1	10.5	10.7	10.8	11.0
Recruiters:[b]					
Navy	3,244	3,316	3,376	3,454	3,808
Army	4,458	4,496	4,364	4,364	4,755
Air Force	1,643	1,622	1,622	1,639	1,907
Marine Corps	2,016	1,959	1,959	1,991	2,092

[a]In constant 1977 dollars adjusted for inflation using the Consumer Price Index.

[b]Recruiters are given here in man-years. Data on Navy recruiters were also available in man-months, and to avoid small rounding errors, these data were used to estimate the model.

economy, the increasing size of the youth pool, and the fluctuations in expenditures on youth programs.

Appendix A contains the data used in our analyses of enlistment supply in FY 1976T-80. Appendix B compares our results with those obtained by previous researchers on the Gates Commission. Appendix C compares results obtained for two measures of relative pay, earnings of youth and earnings of all production workers, which are used to construct the civilian earnings variable.

Only three years of data were available to study two supply factors, student-aid and Navy advertising. For this and other reasons, these factors are separately analyzed in appendices D and E.

Many of the regression variables are deflated by population. Appendix F gives results obtained when variables are not deflated by population.

PREVIOUS ENLISTMENT STUDIES

PRIOR EMPIRICAL RESEARCH

Some of the earliest and most useful studies of enlistment supply were in support of the President's Commission on an All-Volunteer Armed Force (Gates Commission) in 1970. Studies by Gray (15) on all services, Fechter (8) on the Army, and Cook (4) on the Air Force attempted to determine the effect of the draft on military enlistments and the sensitivity of voluntary enlistments to increases in military pay. Despite some formidable obstacles--the obscuring effect of the draft, small sample sizes, and multicollinearity*--Gates Commission researchers provided generally reasonable estimates of the effect of military pay on enlistment supply.

Basically their approach involved using regression analysis to relate enlistments per population to relative military pay, unemployment, draft pressure and other factors. Focusing primarily on mental category 1-3 whites, they found strong positive effects of pay for all services except the Marine Corps (see table 3). For example, elasticities estimated by Gray were 0.82 for the Navy, 1.27 for the Air Force, 1.77 for the Army and -0.12 (wrong sign) for the Marine Corps. The Gates Commission found little or no effect of unemployment (elasticities between zero and 0.24). The effect of population was not estimated; instead population was assumed to have a proportional effect on enlistments (an elasticity of 1.0).**

More recent studies, using AVF era data,*** have broadened the scope to include other enlistment cohorts, and the effects of additional factors such as recruiters, advertising, and population. Researchers have used either time-series, cross-section, or pooled time-series cross-section data to estimate enlistment supply using regression analysis. Table 4 presents previous time series results, and table 5 presents previous cross-section results.

Compared to the Gates Commission, AVF era studies typically find lower effects of pay and higher effects of unemployment. Among the AVF era studies there is a wide range of estimates for pay and unemployment, resulting in part from the type of data used--time series versus cross

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* Highly correlated explanatory variables.

** Our results are compared with those of the Gates Commission in appendix B.

*** A number of studies do begin with fiscal year 1971 data and use the draft lottery experience in fiscal year 1971 through 1973 to infer volunteer rates. However, most recent studies use data only from the AVF era.

TABLE 3

GATES COMMISSION ESTIMATES OF PAY AND UNEMPLOYMENT ELASTICITIES

Researchers (data)	Service	White 1-3s	
		Pay	Unemployment
Fechter			
Quarterly time-series 1Q58-4Q68	Army	1.25	No effect
Cook			
Quarterly time-series 1Q58-2Q67	Air Force	2.23	0.24
Gray			
34 STATE-groups, 1967	Army	1.77[a]	NA
	Navy	0.82[b]	NA
	Air Force	1.27	NA
	Marine Corps	-0.12	NA

[a]Gray used "expected" civilian earnings, i.e., civilian earnings times one minus the unemployment rate.

[b]The corresponding estimate for white HSGs was 1.56.

TABLE 4

ELASTICITIES FROM PREVIOUS AVF ERA TIME-SERIES STUDIES

Service	Author	Period examined	Cohort	Elasticities				
				Pay	Unemployment	Recruiters	Population	Advertising
Army	Fechter (9)[a]	Quarterly 1Q 1958 - 2Q 1974	1-3	0.97*	0.23	NI	1.0	NI
	Fernandez (10)	Monthly Jul 1970 - Sep 1978	1-2	0.88	0.24	0.07	1.0[b]	NI
	Grissmer (17)	Monthly	1-2 HSGs	1.22*	0.42*	NI	1.0[b]	NI
		Jun 1970 - Jul 1975	3 HSGs	1.68*	0.37*	NI	1.0[b]	NI
Navy	Fernandez (10)	Monthly Jul 1970 - Sep 1978	1-2	0.63*	0.65*	NI	1.0[b]	NI
	Goldberg (13)	Quarterly 3Q 1971 - 4Q 1977	1-3A HSGs	0.13	0.51*	1.27	5.0	0.14*
	Greenston and	Quarterly	1-2 HSGs	0.36	0.61*	NI	0.28	NI
	Toikka (16)	3Q 1970 - 4Q 1977	3 HSGs	0.22	1.65*	NI	0.02	NI
	Grissmer (17)	Monthly	1-2 HSGs	0.94	0.50	NI	1.0[b]	NI
		Jun 1970 - Jul 1975	3 HSGs	1.55	0.35	NI	1.0[b]	NI
Air Force	Fernandez (10)	Monthly Jul 1970 - Sep 1978	1-2	0.29	0.63	NI	1.0[b]	NI
	Grissmer (17)	Monthly	1-2 HSGs	0.84*	0.95	NI	1.0[b]	NI
		Jun 1970 - Jul 1975	3 HSGs	0.99*	-0.24	NI	1.0[b]	NI
	Saving (26)	Quarterly	White 1-2 HSGs	0.96[c]	NE	NI	1.0[b]	NI
		3Q 1970 - 4Q 1977	3 HSGs	2.38[c]	NE	NI	1.0[b]	NI
Marine Corps	Cralley (6)	Monthly	1-2 HSGs	not estimated[d]	0.79*	0.36[b]	0.60[b]	NI
		Jul 1973 - Sep 1979	3A HSGs	not estimated[d]	0.91*	0.60[b]	0.30[b]	NI
	Fernandez (10)	Monthly Jul 1970 - Sep 1978	1-2	0.06	1.37*	0.62	1.0[b]	NI
	Grissmer (17)	Monthly	1-2 HSGs	0.74*	1.25*	NI	1.0[b]	NI
		Jun 1970 - Jul 1975	3 HSGs	0.57*	0.62*	NI	1.0[b]	NI
DoD	Grissmer (17)	Monthly	1-2 HSGs	0.89*	0.46	NI	1.0[b]	NI
		Jun 1970 - Jul 1975	3 HSGs	1.15	0.29	NI	1.0[b]	NI

* = statistically significant at the 0.05 level.
NI = not included.
NE = no effect.
[a]Results reported are an average over eight equations (formulations) of the adaptive expectations model. All pay elasticities were statistically significant, while only one of the unemployment elasticities was significant.
[b]Assumed.
[c]Level of statistical significance not given.
[d]Assumed four values for the pay elasticity (for example, 0, 0.5, 1.0, and 1.5) in estimating the effects of unemployment and loss of G.I. Bill benefits.

TABLE 5

ELASTICITIES FROM PREVIOUS AVF ERA CROSS-SECTION STUDIES

Service	Author	Sites/periods examined	Cohort	Elasticities					
				Pay	Unemployment	Own recruiter	Other recruiters	Population	Advertising
Army	Goldberg (14)	47 states, 1973	HSGs	1.12*	NE	0.23	0.50*	0.34[a]	NI
	Huck and Allen (18)	50 states, 1975	1-3A HSDGs[b]	1.16*	0.34*	0.34*	NI	0.65*	NI
	Moore et al. (23)	47 states, 1972, 1973	HSGs 1972	0.60*	0.23	NI	NI	1.0[c]	NI
			1973	0.65*	NE	0.28	NI	0.72[d]	NI
Navy	Borack and Siegel (3)	43 Navy recruiting districts 1977, 1978, 1979	HSDGs, 1977	0.43*	0.16*	0.97[e]	NI	not reported	NI
			1978	0.29*	0.13	0.77[e]	NI	not reported	NI
			1979	0.26	0.08	0.70[e]	NI	not reported	NI
	Goldberg (14)	47 states, 1973	HSGs	NE	0.16	0.41*	0.83*	-0.14[a]	NI
	Huck and Allen (18)	50 states, 1975	1-3A HSDGs	0.61*	0.03	0.56*	NI	0.44*	NI
	Jehn and Shugart (19)	41 Navy recruiting districts, CY 1973, FY 1975	HSGs 1973	1.22*	0.30*	0.12 (0.68)[e]	NI	not reported	NI
			FY 1975	1.26*	0.02	-0.14 (0.69)[e]	NI	not reported	NI
	Moore et al. (23)	47 states 1972, 1973	HSGs 1972	-0.86	0.15	0.75*	NI	0.25[d]	NI
			1973	-0.19	0.23	0.64*	NI	0.36[d]	NI
	Morey (24)	Monthly, Jan 1976-Dec 1978 for 43 recruiting districts	HSGs	0.17*	0.18*	0.73*	NI	0.25*	0.05*
Air Force	Goldberg (14)	47 states, 1973	HSGs	0.63*	0.14	0.83*	0.14	0.08[a]	NI
	Huck and Allen (18)	50 states, 1975	1-3A HSDGs	-0.11	0.25*	0.73*	NI	0.20*	NI
	Looper (21)	Monthly, Apr 1977-Mar 1978, 538 offices	NPS males	NI	NI	0.65[f]	NI	0.13[f]	NI
	Moore et al. (23)	47 states, 1972, 1973	HSGs, 1972	NE	NE	0.84*	NI	0.16[d]	NI
			1973	0.23	0.17	0.69*	NI	0.31[d]	NI
Marine Corps	Cralley (7)	238 recruiting substations, 1978	1-2 HSGs	0.89*	NE	0.36*	NE	0.60*	NI
			1-3A HSGs	0.56*	NE	0.49*	NE	0.44*	NI
	Goldberg (14)	47 states, 1973	HSGs	NE	NE	0.81	NE	0.29[a]	NI
	Huck and Allen (18)	50 states, 1975	1-3A HSDGs	-0.18	-0.06	0.37*	NI	0.57*	NI
	Moore et al. (23)	47 states, 1972 1973	HSGs, 1972	NE	0.11	0.18	NI	0.82[d]	NI
			1973	-0.31	-0.08	0.26*	NI	0.74[d]	NI
DoD	Moore et al. (23)	47 states, 1972 1973	HSGs, 1972	0.12	0.20*	NI	NI	1.0[c]	NI
			1973	0.23	0.11	0.41*	NI	0.59[d]	NI

* = statistically significant at the 0.05 level
NI = not included.
NE = no effect
[a]Statistical significance not given. Elasticity calculated from results.
[b]HSDG is high school diploma graduates. They exclude GEDs.
[c]Assumed.
[d]Assumed to be 1 - elasticity of recruiters.
[e]Elasticity of recruiters holding goals per recruiter fixed.
[f]Level of statistical significance not given.

section.* Researchers using time-series data typically estimate higher elasticities of military pay and unemployment than those using cross section data (see table 6). We suspect the effect of pay may be greater than even the time series estimates (closer to those found by the Gates Commission). The true effect of unemployment is probably within the range of elasticities from the two types of AVF era studies.

Time series estimates of the effect of pay using AVF era data may be biased downward because of demand limitations. Accession goals were cut sharply in FY 1974, e.g., 30 percent by the Navy, and this resulted in low numbers of accessions. With little change in relative military pay in FY 1974, the decline in accession goals reduces the correlation between pay and accessions. This results in a downward bias of the estimate of pay on enlistment supply (more will be said on this point later).

Both recruiters and pay increased in 1972. Time series research has generally omitted recruiters with the warning that pay elasticities may be biased upward. We suspect, however, that the negative bias caused by low accession goals is larger, and that the net effect is a downward bias.

Pay elasticities from cross section studies are probably downward biased because poor measures of civilian earnings were used. Unlike the Gates Commission, AVF era cross section studies did not use civilian earnings of youth in constructing measures of relative military pay. Such data are difficult to obtain on a regional basis and require extensive data processing. Researchers instead used readily available data such as average earnings of all production workers. We will show later in appendix C that use of this measure causes a substantial downward bias of the pay elasticity.

The higher estimates of unemployment elasticities from time series studies are probably more correct, judging from the fluctuations in both enlistments and the economy that occurred in recent years. However, an omitted variable, an OSD policy change, may have led to an upward bias in the time series estimates. Starting in 1975, OSD forced the services to focus more effort on recruiting HSGs, partially because of high unemployment. So unemployment elasticities from time series studies would tend to be picking up this policy change. Estimates from cross section studies may be downward biased because researchers used data on overall

* Another reason for differences among studies is that they focus on different groups. Non-graduates and high school graduates in the lower mental groups tend to be demand limited. Including these groups would result in lower estimates of elasticities. For evidence see appendix B.

TABLE 6

AVERAGES OF ELASTICITIES FROM AVF ERA STUDIES
(Summary of Results Reported in Tables 4 and 5)

Service	Type of study	Relative pay	Unemployment	Recruiters
Army	Time-series	1.22	0.32	NI
	Cross-section	0.88	0.28	0.28
Navy	Time-series	0.64	0.72	1.27[a]
	Cross-section	0.32	0.14	0.69
Air Force	Time-series	1.09	0.45	NI
	Cross-section	0.19	0.14	0.94
Marine Corps	Time-series	0.46	0.99	NI
	Cross-section	0.16	0.0	0.41
DoD	Time-series	1.02	0.38	NI
	Cross-section	0.18	0.16	0.41[a]

[a]Based on only one observation.

unemployment rates rather than those for youth.* However, the Gates Commission used data on youth unemployment and also found small effects.

Over most of the AVF era, there have been only small changes in the number of recruiters. What changes occurred took place in 1972 when there were also increases in pay. As a result, almost all studies focusing on recruiters have used cross section data. These find strong effects and elasticities of about 0.6** This seems like a reasonable magnitude: a 10 percent increase in recruiters generates a six percent increase in enlistees.

Two cross section studies of Navy enlistments, Borack and Siegel (3) and Jehn and Shughart (19), estimate much smaller recruiter elasticities. This is because they included "goal" as a separate explanatory variable. But goal is highly correlated with recruiters; indeed, one does not add a recruiter without giving him a goal, an implicit assumption in the other cross section studies. To estimate the recruiter elasticity from these two studies, goals per recruiter were held constant. In so doing, they yielded recruiter elasticities that are similar to those obtained in other studies. Thus it appears that omitting goal per recruiter does not cause a serious bias of the recruiter elasticity in cross section studies.

The above studies analyzed the effect on enlistment supply of adding own service's recruiters. One cross section study, Goldberg [14] analyzed the cross effects of adding other services' recruiters. This is a very important issue: if recruiters generate enlistments at the expense of other services, it would severely limit their use for meeting DoD-wide shortfalls. This study found positive cross effects rather than net competitive effects. In the same vein, another study, Moore et al. [23], analyzed the effect of recruiters on DoD enlistments. It found positive effects of recruiters on DoD enlistments.

Declines in the youth population in the 1980s of 15-20 percent are likely to hamper recruiting, and some feel this will require a return to the draft. To forecast the effect of population declines requires an estimate of the elasticity of population.

Most studies do not provide evidence on the effects of population; they assume a proportional effect (an elasticity of 1.0). Some studies, e.g. Moore et al., assume a proportional effect for population and recruiters. This assumption seems to be more correct. There is evidence that the elasticities of population and recruiters do sum to about one (see table 7). Thus the elasticity of population appears to

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* Another possible reason is that cross section unemployment rates may vary directly with omitted factors such as pleasant weather, unfavorable attitudes toward the military, and low ability of the population.
** Average of the cross section estimates given in table 6.

TABLE 7

RECRUITER AND POPULATION ELASTICITIES

Study (Cohort)	Service	Recruiters		Population	Sum
		Own service	Other services		
Huck and Allen (1-3A HSDG)	Army	0.34	NI	0.65	0.99
	Navy	0.56	NI	0.44	1.00
	Air Force	0.73	NI	0.20	0.93
	Marine Corps	0.37	NI	0.57	0.94
Goldberg (HSG)	Army	0.23	0.50	0.34	1.07
	Navy	0.41	0.83	-0.14	1.10
	Air Force	0.83	0.14	0.08	1.05
	Marine Corps	0.81	NE	0.29	1.10
Cralley (1-3A HSG)	Marine Corps	0.49	NI	0.44	0.93
Morey (HSG)	Navy	0.73	NI	0.25	0.98
Looper (non-prior-service males)	Air Force	0.65	NI	0.13	0.78

Source: Tables 4 and 5.

be less than 1.0, which implies that population declines may have less serious effects than some have imagined.

Intuitively, this means that if population falls and the number of recruiters does not, there is a decrease in the number of potential recruits per recruiter. This allows recruiters to spend more effort on each potential recruit. In some cases this means that people will be contacted who otherwise would not have been. In other cases it means that there will be multiple, or more intense, contacts. This increases the likelihood of any individual joining up. It provides a partial offset to the fact that the number of individuals is smaller. Thus, the effect of population declines on accessions is less than proportional.

One additional point deserves to be made about the effect of shrinking youth cohorts. As teenagers become a smaller part of the population, it is likely that their wages will rise relative to other segments of the labor force. This has been found by Wachter (28) and Welch (29). In addition, the unemployment rate of this group may fall. If the Navy is not allowed to keep pace with the rising relative earnings of youth, the declining teenage population will have a somewhat more serious impact on recruiting than has been depicted thus far. Similarly, if youth unemployment falls, additional recruiting resources may be required.

A problem with these cross section estimates is that recruiters and population are highly correlated.* The studies show that a doubling of recruiters and population results in about a doubling of enlistments, and it appears that each contributes to the increase in supply. We obtain similar findings, but given the highly collinear variables, one must be cautious about interpreting the elasticities as partial effects. As a check, it would be a good idea to forecast enlistments in a period when recruiters increased and population was fixed. We undertake such a forecasting test in FY 1980. The results support the finding of a separate substantial effect for recruiters.

In addition, the recruiter variable may be picking up the effect of other, omitted variables. This might cause the impact of additional recruiters to be overstated and, perhaps, the effect of population declines to be understated. This possibility is discussed more fully in the section entitled "Findings". It is not found to be empirically important.

There have been two studies of Navy advertising, Goldberg [13] and Morey [24]. Both find small positive effects, i.e., elasticities of .05 to .14.

* Correlations are about 0.85 (see table F-4).

GI Bill benefits were drastically reduced in 1977. There is little evidence on the effects of this loss of GI Bill benefits, although many believe that the effects were substantial. The only evidence is from Cralley [6], who estimates that for the Marine Corps it caused about a 15 percent decline in 1-3A HSGs.

MEASUREMENT PROBLEMS

AVF era studies have been plagued by a variety of measurement problems, which may explain differences in estimates among them. As in the earlier Gates Commission studies, these studies have had to contend with limited samples, multicollinearity, and omitted variables. Some of these problems have already been mentioned: in time series studies, collinearity between pay and recruiters; in cross section studies, error in measurement of civilian pay and unemployment, and collinearity between recruiters and population. Other problems are reviewed below.

The principal time series studies are those by Fernandez [10], Grissmer [17], and Saving, etal., [26]. While yielding some useful insights, these studies (and the cross section studies) have not been good predictors of enlistment supply. The study by Fernandez, for example, failed to predict the recruiting declines of fiscal years 1978 and 1979 and the substantial increases of fiscal years 1980 and 1981.

One problem is that time-series studies used data on accessions from periods in which all of the services achieved or exceeded their enlistment objectives. In fiscal year 1974 (and to some extent in 1975), enlistment goals were very low in spite of a downturn of the economy. Under these circumstances the studies would observe less than the true level of supply (see figure 1).

Adding to the problem of sometimes not being on a supply curve is that of changing standards: when enlistment goals increase, quality standards used as screens on enlistments tended to drop.* Most time-series have not attempted to account for the effects of changes in goals and standards.** A related problem facing researchers using time-series data is the misnorming of entry tests that occurred from fiscal year 1977 through fiscal year 1980. These problems make it very difficult to measure the effects of supply factors or predict enlistments with just time series data.

Except for Saving, researchers who use time series data have measured enlistment supply with data on accessions rather than contracts. Contracts are the numbers of enlistees who sign contracts to join the military. Accessions are the number who enter active duty. An enlistee

* For evidence see Navy Recruiting Command (25).
** For the two exceptions, see Goldberg (13) and Greenston and Toikka (16).

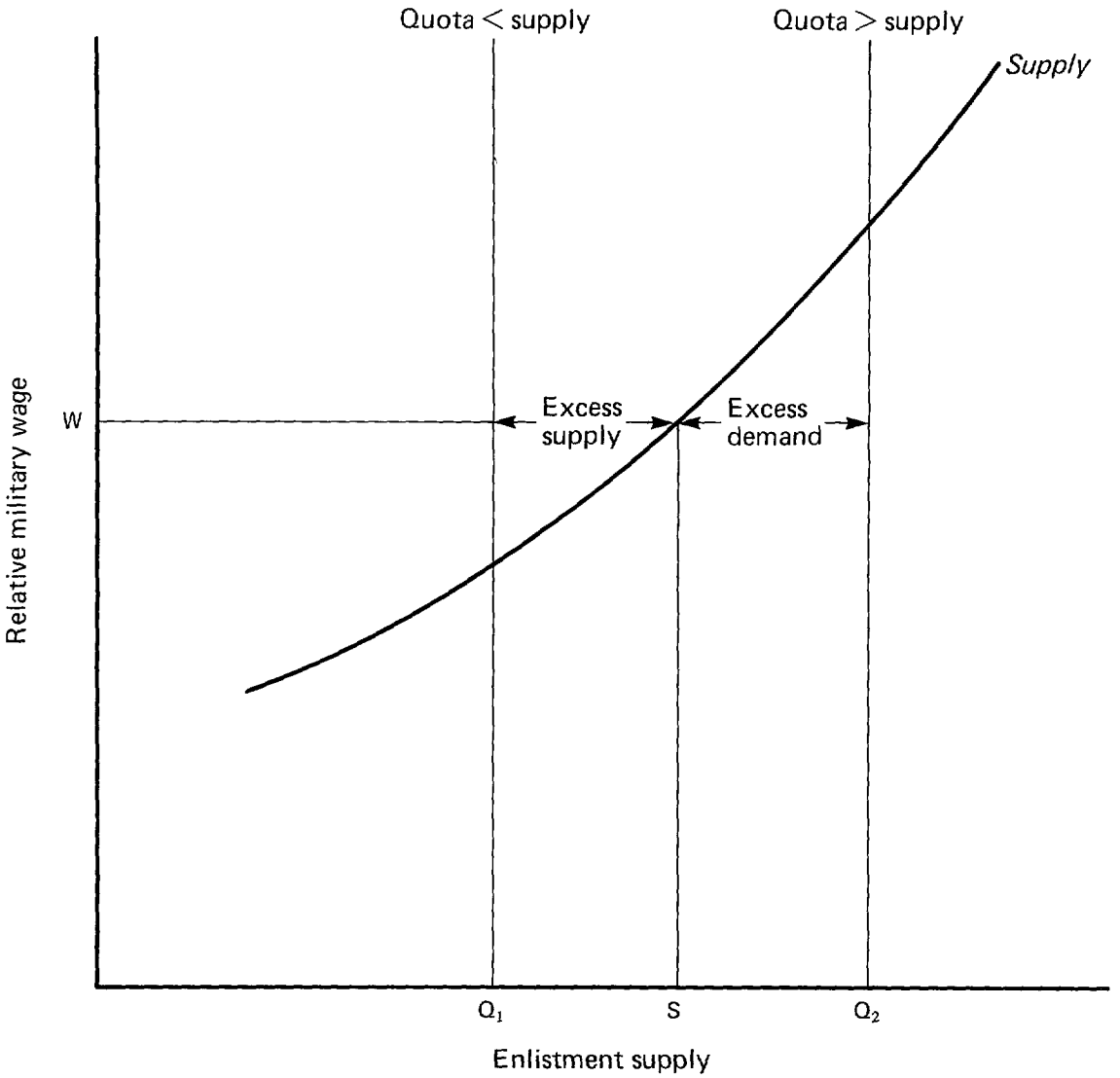

FIG. 1: SUPPLY AND DEMAND FOR ENLISTMENTS

Note:
If $Q < S$, enlistments are less than S, which is the true level of supply when the wage is W. If wages increase, we still observe only Q_1 enlistments. If $Q > S$, enlistments equal S; and if wages increase, we observe the effect of wages on enlistments.

who signs a contract in the current year may be added to a "delayed entry pool" (DEP) and enter in the following year.*

The services use the delayed entry pool to dampen the effects of changes in supply. As supply changes, contracts will change but accessions may not, especially if accession goals are achieved. Thus, contracts are a better measure of enlistment supply.

Figure 2 gives Navy nonprior service male 1-3A contracts minus accessions (the change in the delayed entry pool (D)) for FY 1976T-80 as a function of the percent of goal achieved by the Navy. In FY 1981 there was a sharp downturn of the economy and 100.5 percent of accession goals were achieved. Still, Navy recruiters wrote nine percent more contracts than accessions. In the earlier years FY 1977-79 when there was an upturn of the economy and 94 percent of goal was achieved, contracts were less than accessions. The greater volatility of contracts in response to changes in supply factors makes it more suitable for estimating supply functions.

We know that the other services achieved their enlistment goals in FY 1981, and in that year nonprior service male 1-3A contracts were about 13 percent greater than accessions for each of the other services.

There are many problems in using time series or cross section data to measure enlistment supply and as a result estimates of effects vary widely. We doubt that just the use of contracts would eliminate the differences in estimates; however, it is a step in the right direction.**

To overcome some of the problems encountered in time series studies, Morey pooled time-series and cross-section data to estimate Navy enlistment supply in 1976 through 1978. The data were monthly observations on enlistment contracts in Navy recruiting districts. The Morey study sheds light on the effects of recruiters, advertising and population. But it is limited by measurement problems in test scores and civilian earnings and by ommission of variables; like other studies, it does not accurately predict the upturn in enlistments in FY 1980-81. While some of the measurement problems are potentially correctable, the use of monthly observations makes it very difficult to obtain accurate measures of the supply of enlistments.

Monthly enlistment rates are dominated by strong seasonal patterns. These patterns imply the existence of a complex serial correlation scheme in the monthly series of enlistments and require the use of a sophisticated estimation procedure to take seasonality into account.

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* Our measure of contracts takes into account attrition from the delayed entry pool.

** For evidence see Saving (26).

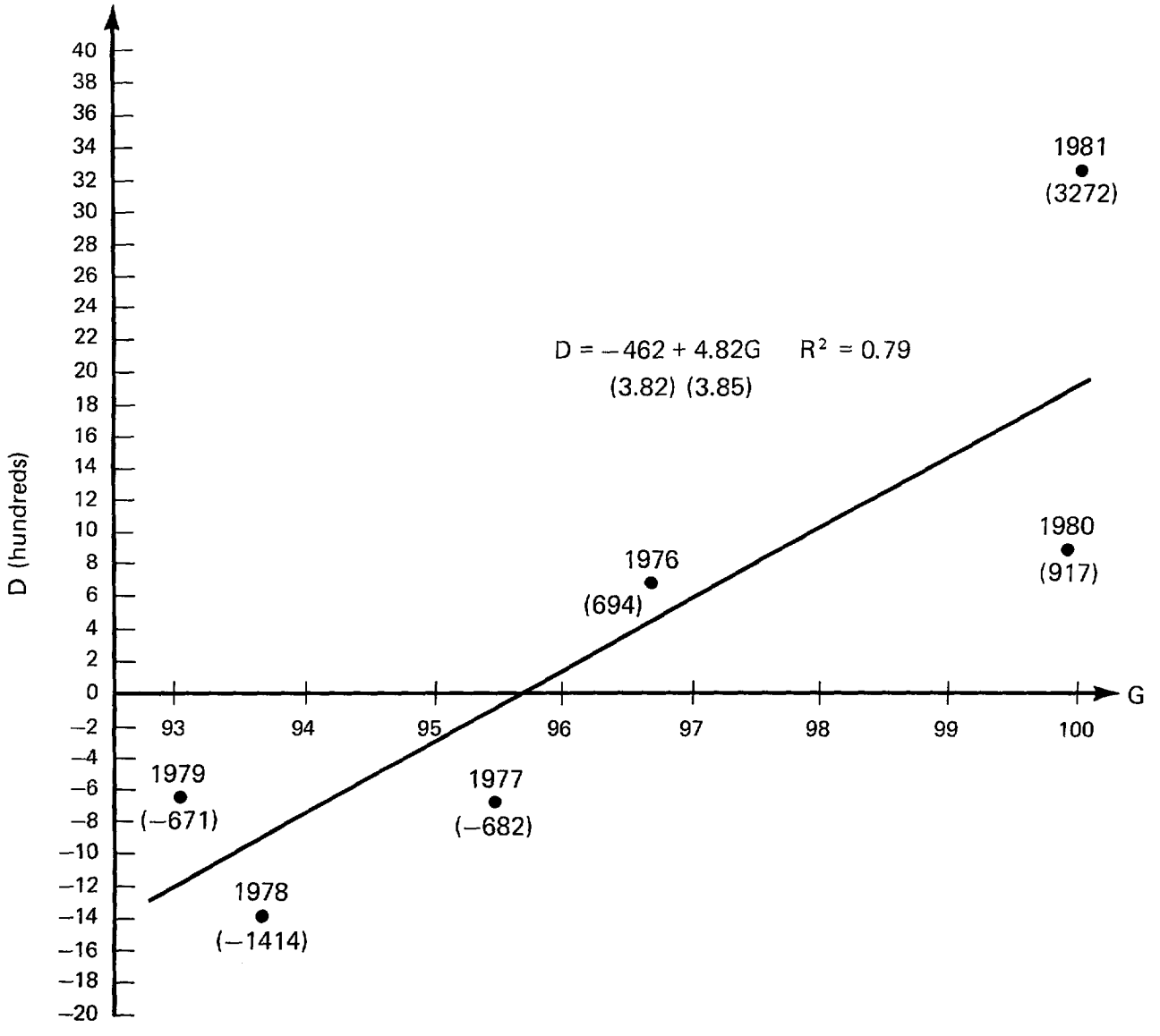

FIG. 2: DIFFERENCE BETWEEN NAVY 1-3A CONTRACTS AND ACCESSIONS (D) AS A FUNCTION OF PERCENT OF NPS MALE GOAL ACHIEVED (G)

The seasonality makes it difficult to measure the effects of other factors. Furthermore, seasonal patterns can change suddenly and dramatically, as when the GI Bill was repealed at the end of 1976. An approach that uses annual observations would be immune to changing seasonal patterns or the use of an inappropriate procedure to adjust for serial correlation. Finally, it is frequently impossible to measure the explanatory variables accurately on a month to month basis, and the resulting measurement error would bias the estimated supply coefficients.

DEALING WITH MEASUREMENT PROBLEMS: A PREVIEW

We overcome some of the measurement problems encountered in earlier AVF era studies by using more and better pooled time-series cross-section data for 1976T-80. We measure enlistments with contract data from the 43 Navy recruiting districts in existence in FY 1976T-80.* Contract data eliminate some biases induced by demand limitations. In addition, over much of this period recruiting goals were not achieved, and so recruiters were probably making a maximum effort to attract enlistees. Moreover, the contract data are properly normed to reflect mental standards in effect in FY 1981. We also obtain regional data on civilian earnings of youth and include other explanatory factors, e.g., ETA programs and other service recruiters. Finally, annual observations are used--making it easier to estimate the long-run effects of supply factors.

By using more and better annual pooled data, we: (1) provide improved estimates of the effects of military pay, recruiters, Navy advertising and population; (2) estimate the effects for each service of the loss of GI Bill benefits in 1977; and (3) develop a model that accurately forecasts enlistments. The results are used to analyze recruitment policies and forecast enlistments in the 1980s.

* In FY 1980 there were 41.

METHODS

THEORETICAL MODEL

In a standard enlistment supply model,* it is assumed that an individual has a "reservation wage" that would make the benefits of enlisting, both pecuniary and nonpecuniary, equal to the benefits of not enlisting. An individual enlists if the military wage is greater than the reservation wage. Specifically, let:

W_1 = military earnings

B_1 = the monetary equivalent of the nonpecuniary benefits of enlisting.

W_2 = civilian earnings

B_2 = the monetary equivalent of the nonpecuniary benefits of not enlisting.

The reservation wage is $W_2 + B_2 - B_1$. If the actual military wage, W_1, is greater than the reservation wage, the individual enlists: this decision yields the greatest total benefits.

Differences in reservation wages among individuals are due to differences in net tastes for military service ($B_2 - B_1$) and civilian earnings opportunities (W_2). Thus, other things being equal, aggregate enlistment supply will depend positively on the size of the youth population and negatively on civilian employment opportunities, i.e., economic factors that increase W_2.

Underlying this theory is the assumption that individuals have sufficient information regarding all alternatives to choose rationally among them. But this is not true. Due to lack of information, individuals seriously consider only a small subset of all possible employment opportunities.

Recruiting provides information concerning the benefits of enlisting. As a result, more individuals consider enlisting and more choose to enlist over the other alternatives known to them. Thus, we expect that an increase in recruiting resources will increase enlistment supply.

However, the effect on each service's enlistments of an increase in just one service's recruiters is unclear. An increase in, say, Navy recruiters might draw some enlistees to the Navy who might otherwise

* For alternative discussions of the theory, see [1, 8, and 12].

have joined the Army. On the other hand, by increasing interest in the military in general, the Navy recruiter might increase enlistment supply to the other services. (As mentioned, a previous study found positive cross effects.)

ECONOMETRIC MODEL

We use regression analyses to estimate the effects of supply factors on the number of contracts signed in Navy recruiting districts by nonprior service male HSGs. Regression models are estimated for each service and DoD as a whole with annual data for FY 1976T-80.

We could assume that a service's demand for HSGs is greater than the available supply. This implies that the number of enlistment contracts signed in a district depends on the level of supply factors. However, enlistments of HSGs in the lower mental groups might be limited by recruiting goals. So for each service and DoD, we separately estimate the regression model for all HSGs and for those in the upper mental groups, 1-3A and 1-2.

The services have been criticized for having proportionately more blacks than is representative of the civilian population. To achieve a more representative racial mix, the services, especially the Army, may be recruiting whites more actively than blacks. Because of this possibility, we separately analyze the supply of enlistments for all races combined and for whites.

Specification of the Model

For purposes of estimation, our theoretical analysis of enlistment supply suggests that the supply of enlistees depends upon economic factors, demographic factors, and recruiting resources. The economic factors include relative military pay, GI Bill benefits, civilian unemployment, and federal youth programs; the demographic factors are population and race; and the recruiting resources are recruiters of each service and Navy advertising. We would have liked to include a measure of advertising by all the services, but the data were not available.

The number of HSGs per population in a recruiting district is assumed to be a log-linear function of supply factors:

$$\begin{aligned} \text{Ln } H = {} & a_0 + a_1 \text{ LRPAY} + a_2 \text{ LUNEM} + a_3 \text{ LETAY} + a_4 \text{ LETAC} \\ & + a_5 \text{ LNREC} + a_6 \text{ LAREC} + a_7 \text{ LFREC} + a_8 \text{ LMREC} + a_9 \text{ LPOP} \\ & + a_{10} \text{ BLK} + a_{11} \text{ VEAP} + \text{error term} \end{aligned} \qquad (1)$$

For each service and DoD, H is the number of enlistment contracts for all HSGs, mental group 1-3A HSGs, or mental group 1-2 HSGs divided by the recruiting district's total (or white) population of 17-21 year old males. Definitions of the explanatory variables are given below:

Relative Military Pay

LRPAY = logarithm of regular military compensation for an unmarried E_1 enlistee having less than two years of service divided by annual full time earnings of 18 year old civilian males.*

Holding other factors fixed, the ratio of military to civilian pay is expected to have a positive effect on the supply of high school graduates. To measure relative military pay, we use the ratio of first year military compensation to civilian earnings.** Under the assumption that earnings growth rates of enlistees and civilians during an enlistee's first term are constant, this is equivalent to using the ratio of discounted earnings streams.

We expect that an increase in relative military pay will increase enlistment supply.

Civilian Unemployment

LUNEM = logarithm of the unemployment rate for all civilians.

As the unemployment rate increases, expected civilian earnings decline and it becomes more difficult and costly to find a civilian job. The overall unemployment rate of all civilians in the district is used to measure unemployment.*** We expect increases in unemployment will increase supply.

Youth Programs

LETAY = logarithm of expenditures by ETA for youth oriented programs per population of 17-21 year old males.

* For details on the construction of the pay and other variables, see appendix A. Studies have used as a measure of civilian pay average hourly earnings of all production workers. This measure is not as good as the earnings of youth used in this study (see appendix C.)
** It is for convenience in the estimation that we use the first year ratio to measure relative military pay over the first term. For policy analysis purposes, we do examine the effect of a pay change, e.g., a bonus, on the entire discounted earnings stream.
*** We would have preferred to use youth unemployment rates, but reliable measures could not be constructed for Navy recruiting districts.

LETAC = logarithm of expenditures by ETA for countercyclical programs per population of 17-21 year old males.

Federal youth programs have a potentially negative effect on enlistment supply. One group of programs is sponsored by the Department of Labor's Employment and Training Administration (ETA). These programs provide pay and training for civilians. Some are oriented entirely toward youths. Funding for these was about $2.4 billion in FY 1978. Others affect both youths and adults and are countercyclical in nature. Funding for these was about $5.3 billion in FY 1978. Countercyclical ETA programs increased by $2.6 billion in FY 1978 as part of a $25 billion economic stimulus package implemented by the Carter Administration.*

Another group of federal programs is sponsored by the Department of Education. They provide financial assistance for students: total funding was $4.6 billion in FY 1978. Student-aid programs increased sharply in the 1970s, and there is speculation that this caused the DoD-wide decline in enlistments in FY 1978-79. We doubt it, because increases in most programs occurred well before the enlistment declines of FY 1978. Unfortunately, data on student-aid programs are available for only FY 1977-79. A preliminary analysis of these programs is contained in appendix D.

Loss of the GI Bill

VEAP = dummy variable equal to zero in FY 1976T and one in FY 1977-80 measuring the net effect of the changeover from the GI Bill to the Veterans Education Assistance Program (VEAP).

Educational benefits were substantially reduced in January 1977 with the switchover from the GI Bill to VEAP. We expect that the switch decreased the supply of enlistees. We measure the net effects of the change, using a dummy variable, VEAP.**

* For a breakdown of the youth and countercyclical ETA programs, see appendix A.
** For the appropriateness of using a dummy variable to measure the effects of the loss of GI Bill benefits, see Fernandez [11].

Demographic Factors

LPOP = logarithm of a district's 17-21 year old male population (in thousands).

Population is measured using census data on the total number of 17-21 year old males in a Navy recruiting district. We expect that an increase in this population will increase enlistment supply.

BLK = percent of a district's 17-21 year old male population that is black.

Blacks on average score lower than whites on the entrance tests in the Armed Services Vocational Aptitude Battery (ASVAB). The percent of the total population in a district that is black is used to adjust for this difference. Districts having a higher percentage of blacks are expected to have lower enlistment rates of HSGs in the upper mental groups and higher enlistment rates of HSGs in the lower mental groups.

Recruiters

LNREC = logarithm of Navy production recruiters per population of 17-21 year old males.

LAREC = logarithm of Army production recruiters per population of 17-21 year old males.

LFREC = logarithm of Air Force production recruiters per population of 17-21 year old males.

LMREC = logarithm of Marine Corps production recruiters per population of 17-21 year old males.

We analyze the effects of each service's recruiters on each service's enlistment supply. A service's recruiters are expected to increase its enlistment supply but, as mentioned previously, the cross effects of a services's recruiters are uncertain.

We also estimate the effect on Navy enlistment supply of Navy advertising. Estimates are obtained using regression analyses with three years of district-level data for FY 1977-79. Besides local advertising, we analyze two types of national advertising: "broadcast" and "print". We expect Navy enlistment supply to be increased by Navy advertising.

Unfortunately, district level advertising data were unavailable for the other services. For this reason and because a different, more complicated methodology was used, we separately report the results of these analyses in appendix E.

The log-linear functional form permits diminishing marginal returns with increases in supply factors, such as recruiting resources. It also permits the productivity of recruiting resources to be affected by the levels of other factors, such as relative military pay. Thus, as relative military pay increases, we expect the productivity of recruiters to increase.

With the exception of population, percent black and VEAP, the regression coefficients are "partial elasticities," i.e., the percentage that total supply changes when a supply factor increases by one percent and all other factors are held fixed. The elasticity of total enlistment supply with respect to population is given by a_{12}:*

$$a_{12} = 1 + a_9 - (a_3 + a_4 + \ldots + a_8) \qquad (2)$$

The coefficient of BLK, a_{10}, is the percentage change in the enlistment rate caused by a one point increase in the percent of the population that is black. The coefficient of the VEAP dummy variable measures the percentage change in enlistment supply caused by the introduction of VEAP.

Estimation Procedure and Test

The models are estimated using the ordinary least squares procedure. In using pooled data for FY 1976T-80, we assume stable regression parameters over time. This assumption is examined using the Chow test, and in most instances (24 out of 30) the test is passed.** In conversation, the Air Force indicated that changes in recruiting

* Derived by grouping all logarithm of population terms on the right side of equation (1). To obtain a direct estimate of a_{12}, equation 1 was also estimated without deflating enlistments or supply factors by population. Estimates and standard errors of elasticities, including population, are identical with those reported for equation 1 and are reported in appendix F.

** For discussion of the test, see [22], pp. 322-326. Residuals were also visually examined. They appear to be randomly distributed both over time and among districts. Initially, the residuals for the Air Force in FY 1980 were mostly negative. Inclusion of a dummy variable for FY 1980 eliminated this problem.

policies might have increased supply in FY 1980.* To adjust for these changes we included a dummy variable in the Air Force equation for FY 1980.**. This sort of adjustment was not necessary for the other services.

* We suspect that changes in DEP policies, the addition of new enlistment options and changes in physical standards caused the increases in Air Force supply in FY 1980.

** Inclusion of the dummy variable had little effect on the estimates of the other coefficients, and, to our surprise, the Air Force Models passed the Chow test for pooling even without the inclusion of the FY 1980 dummy variable.

FINDINGS

THE EFFECTS OF SUPPLY FACTORS

Tables 8-12 present the regression results obtained for the three enlistment cohorts under study. A separate table is devoted to each service and DoD. The determinants of enlistments are quite similar across the services and for DoD as a whole. Relative military pay, GI Bill benefits, unemployment, population, a service's own recruiters, and recruiters of the other services increase enlistments, while ETA programs decrease them. The black population reduces the supply of enlistments for the upper mental groups, but increases it for the lower mental groups. To simplify the discussion, we will focus on the results for 1-3A HSGs.

Relative Military Pay and Unemployment

Pay, besides being highly significant statistically, has a very strong effect on enlistment supply. A one percent increase in relative military pay would cause the supply of 1-3A HSGs to increase by 0.99 percent for the Navy, 2.13 percent for the Army, 1.14 percent for the Air Force, 0.53 percent for the Marine Corps, and 1.21 percent for DoD as a whole. The findings are consistent with those of the Gates Commission when one adjusts for differences in cohorts analyzed.*

The effect of unemployment is statistically significant across the services except for the Army. The elasticities range from -0.08 (not significant) for the Army to 0.26 (highly significant) for the Navy. Use of overall unemployment rate instead of youth unemployment may have caused us to obtain elasticities that are too low, especially for the Army. However, earlier cross section studies by Gray [15] and Moore etal. [23] using youth unemployment also estimated small elasticities, so the apparent bias may be caused by some other problem, e.g., omitted factors or simultaneity.

Both relative military pay and unemployment affect supply, but the effect of pay is apparently more important. During the upturn of the economy in FY 1978, there were declines in relative military pay of nine percent and in unemployment of 20 percent. Together, these two factors caused DoD enlistment supply to decline by about 15 percent in FY 1978. Most of the decline, however, was caused by civilian pay rising more quickly than military pay. Thus, if military pay keeps up with civilian pay, cyclical fluctuations in enlistment supply can be substantially reduced.

* See appendix B.

TABLE 8

NAVY ENLISTMENT SUPPLY MODELS

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Constant	1.26 (3.02)[a]	1.59 (3.33)	1.54 (3.38)	1.81 (3.58)	1.29 (2.63)	1.45 (2.78)
Relative pay	0.93 (7.65)	1.05 (7.49)	0.99 (7.42)	1.02 (6.89)	0.98 (6.94)	1.00 (6.51)
Unemployment	0.31 (6.48)	0.32 (5.70)	0.26 (4.84)	0.26 (4.37)	0.24 (4.39)	0.24 (4.00)
Loss of GI Bill	-0.0039 (0.28)	-0.043 (1.11)	-0.12 (3.09)	-0.12 (3.02)	-0.10 (2.65)	-0.12 (2.80)
ETA youth	-0.049 (0.70)	-0.0093 (0.12)	-0.15 (1.92)	-0.087 (1.06)	-0.19 (2.41)	-0.12 (1.41)
ETA countercyclical	-0.075 (2.50)	-0.10 (2.92)	-0.072 (2.19)	-0.094 (2.60)	-0.075 (2.17)	-0.094 (2.51)
Navy recruiters	0.44 (6.28)	0.37 (4.66)	0.46 (6.13)	0.40 (4.81)	0.52 (6.51)	0.46 (5.31)
Army recruiters	0.30 (2.71)	0.17 (1.48)	0.24 (2.00)	0.044 (0.36)	0.26 (2.06)	0.052 (0.40)
Air Force recruiters	0.44 (4.91)	0.51 (4.95)	0.56 (5.67)	0.59 (5.46)	0.55 (5.25)	0.56 (4.98)

TABLE 8 (Cont'd)

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Marine Corps recruiters	-0.094 (1.30)	-0.21 (2.51)	0.023 (0.29)	-0.072 (0.83)	0.071 (0.85)	-0.017 (0.19)
Percent black population	0.0073 (4.67)	N.A. -	0.00 (0.0047)	N.A. -	-0.0018 (1.03)	N.A. -
Total (or white) population	0.14 (3.27)	0.066 (1.50)	0.19 (4.13)	0.088 (1.89)	0.22 (4.50)	0.11 (2.36)
R^2	0.63	0.65	0.72	0.65	0.72	0.64
Regression F	39.70 (11,203)	38.21 (10,204)	47.82 (11,203)	38.48 (10,204)	47.43 (11,203)	36.01 (10,204)
Pooling F	1.74 (43,160)	1.46 (39,165)	1.69[b] (43,160)	1.83[b] (39,165)	1.44 (43,160)	1.60[b] (39,165)
SER[c]	0.15	0.18	0.17	0.19	0.18	0.19

[a]Given in parentheses are t-values for parameter estimates.
[b]Significant at .05 level, indicating that the test for pooling is not passed.
[c]Standard error of the regression.

TABLE 9

ARMY ENLISTMENT SUPPLY MODELS

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Constant	2.83 (4.90)[a]	2.87 (3.84)	2.52 (4.57)	3.23 (5.60)	2.37 (4.25)	2.98 (5.13)
Relative pay	2.06 (12.26)	2.13 (9.74)	2.13 (13.22)	2.00 (11.82)	2.04 (12.58)	1.95 (11.50)
Unemployment	0.037 (0.56)	0.14 (1.63)	-0.08 (1.28)	0.0011 (0.017)	-0.044 (0.68)	0.015 (0.22)
Loss of GI Bill	-0.027 (0.56)	-0.012 (0.19)	-0.30 (6.50)	-0.23 (4.78)	-0.31 (6.75)	-0.25 (5.29)
ETA youth	-0.20 (2.09)	-0.30 (2.48)	-0.16 (1.78)	-0.28 (2.99)	-0.17 (1.86)	-0.28 (2.35)
ETA countercyclical	0.0060 (0.13)	0.042 (0.72)	-0.054 (1.26)	0.074 (1.63)	-0.097 (2.20)	-0.11 (2.35)
Navy recruiters	0.29 (3.03)	0.45 (3.68)	0.16 (1.78)	0.24 (2.55)	0.18 (1.92)	0.25 (2.59)
Army recruiters	0.060 (0.40)	0.54 (2.94)	0.30 (2.07)	0.58 (4.08)	0.33 (2.25)	0.56 (3.87)
Air Force recruiters	0.22 (1.76)	0.35 (2.15)	0.29 (2.42)	0.50 (3.93)	0.35 (2.89)	0.52 (4.13)

TABLE 9 (Cont'd)

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Marine Corps recruiters	0.14 (1.42)	0.10 (0.80)	0.28 (2.97)	0.29 (2.96)	0.35 (3.66)	0.37 (3.67)
Percent black population	0.018 (8.36)	N.A. -	-0.01 (4.89)	N.A. -	-0.015 (7.24)	N.A. -
Total (or white) population	-0.0050 (0.086)	0.16 (2.22)	0.18 (3.24)	0.22 (4.18)	0.22 (3.93)	0.26 (4.76)
R^2	0.70	0.56	0.74	0.74	0.78	0.75
Regression F	42.40 (11,203)	25.98 (10,204)	53.64 (11,203)	56.61 (10,204)	67.24 (11,203)	61.47 (10,204)
Pooling F	0.52 (43,160)	0.39 (39,165)	1.41 (43,160)	0.96 (39,165)	1.42 (43,160)	1.17 (39,165)
SER[b]	0.21	0.28	0.20	0.21	0.21	0.22

[a]Given in parentheses are t-values for parameter estimates and degrees of freedom for F-statistics.
[b]Standard error of the regression.

TABLE 10

AIR FORCE ENLISTMENT SUPPLY MODELS

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Constant	1.77 (3.88)[a]	2.42 (4.75)	1.80 (3.72)	2.48 (4.76)	1.62 (3.22)	2.14 (4.05)
Relative pay	1.16 (8.38)	1.18 (7.58)	1.14 (7.74)	1.17 (7.33)	1.21 (7.84)	1.23 (7.60)
Unemployment	0.11 (2.15)	0.13 (2.12)	0.14 (2.40)	0.13 (2.19)	0.17 (2.96)	0.16 (2.69)
Loss of GI Bill	0.059 (1.52)	0.047 (1.08)	-0.10 (2.42)	-0.086 (1.97)	-0.10 (2.45)	-0.095 (2.12)
ETA youth	0.036 (0.46)	0.0058 (0.069)	-0.036 (0.44)	-0.10 (1.16)	-0.084 (0.98)	-0.13 (1.49)
ETA countercyclical	-0.060 (1.41)	-0.087 (1.81)	-0.057 (1.24)	-0.065 (1.32)	-0.076 (1.60)	-0.081 (1.63)
Navy recruiters	0.22 (2.91)	0.22 (2.60)	0.26 (3.20)	0.26 (3.10)	0.31 (3.73)	0.31 (3.60)
Army recruiters	0.24 (1.96)	0.28 (2.12)	0.21 (1.62)	0.22 (1.62)	0.22 (1.60)	0.23 (1.68)
Air Force recruiters	0.47 (4.36)	0.63 (5.30)	0.46 (4.00)	0.62 (5.06)	0.50 (4.23)	0.63 (5.08)

TABLE 10 (Cont'd)

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Marine Corps recruiters	-0.049 (0.63)	-0.17 (1.98)	0.083 (0.99)	-0.036 (0.041)	0.18 (2.10)	0.10 (1.15)
Percent black population	0.00 (0.018)	N.A. -	-0.0062 (3.41)	N.A. -	-0.0089 (4.72)	N.A. -
Total (or white) population	0.048 (1.00)	0.0033 (0.067)	0.086 (1.68)	0.052 (1.03)	0.12 (2.36)	0.097 (1.91)
1980 DEP policy change	0.23 (5.88)	0.20 (4.52)	0.14 (3.47)	0.14 (3.09)	0.13 (2.98)	0.13 (2.81)
R^2	0.64	0.62	0.67	0.63	0.72	0.66
Regression F	29.41 (12,202)	30.34 (11,203)	34.82 (12,202)	31.53 (11,203)	44.53 (12,202)	36.78 (11,203)
Pooling F	0.66 (42,160)	0.73 (38,165)	0.64 (42,160)	0.73 (38,165)	0.75 (42,160)	0.84 (38,165)
SER[b]	0.17	0j.19	0.18	0.19	0.10	0.20

[a]Given in parentheses are t-values for parameter estimates and degrees of freedom for F-statistics.
[b]Standard error of the regression.

TABLE 11

MARINE CORPS ENLISTMENT SUPPLY MODELS

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Constant	0.89 (1.48)[a]	1.63 (2.64)	1.42 (2.25)	2.34 (3.75)	1.32 (2.05)	2.21 (3.49)
Relative pay	0.47 (2.68)	0.58 (3.22)	0.53 (2.89)	0.58 (3.20)	0.57 (3.08)	0.58 (3.13)
Unemployment	0.26 (3.70)	0.32 (4.43)	0.23 (3.09)	0.24 (3.28)	0.21 (2.88)	(0.22) (2.99)
Loss of GI Bill	0.11 (2.14)	0.064 (1.26)	-0.15 (2.91)	-0.11 (2.21)	-0.16 (3.05)	-0.13 (2.45)
ETA youth	0.11 (1.09)	-0.028 (0.28)	0.046 (0.43)	-0.10 (1.01)	-0.032 (0.30)	-0.15 (1.52)
ETA countercyclical	-0.12 (2.55)	-0.16 (3.21)	-0.18 (3.72)	-0.20 (4.19)	-0.22 (4.30)	-0.23 (4.70)
Navy recruiters	0.20 (2.06)	0.26 (2.61)	0.20 (1.91)	0.25 (2.48)	0.29 (2.73)	0.32 (3.04)
Army recruiters	0.42 (2.67)	0.65 (4.23)	0.39 (2.34)	0.56 (3.66)	0.39 (2.31)	0.49 (3.11)
Air Force recruiters	-0.22 (1.66)	0.060 (0.44)	-0.12 (0.86)	0.14 (1.00)	-0.035 (0.25)	0.18 (1.29)

TABLE 11 (Cont'd)

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Marine Corps recruiters	0.68 (6.52)	0.48 (4.50)	0.88 (8.04)	0.77 (7.16)	0.92 (8.35)	0.86 (7.89)
Percent black population	0.0058 (2.57)	N.A. -	-0.012 (5.06)	N.A. -	-0.014 (5.90)	N.A. -
Total (or white) population	0.056 (0.93)	0.12 (2.05)	0.13 (2.04)	0.16 (2.81)	0.20 (3.02)	0.21 (3.53)
R^2	0.42	0.58	0.71	0.68	0.75	0.70
Regression F	13.35 (11,203)	28.79 (10,204)	45.70 (11,203)	43.56 (10,204)	55.74 (11,203)	47.78 (10,204)
Pooling F	0.98 (43,160)	0.88 (39,165)	0.78 (43,160)	1.09 (39,165)	1.16 (43,160)	1.56[b] (39,165)
SER[c]	0.22	0.23	0.23	0.23	0.24	0.23

[a]Given in parentheses are t-values for parameter estimates.
[b]Significant at .05 level, so the test for pooling is not passed.
[c]Standard error of the regression.

TABLE 12

DOD ENLISTMENT SUPPLY MODELS

	All HSGs		1-3A-HSGs		1-2 HSGs	
Explanatory variable	Total	Whites	Total	Whites	Total	Whites
Constant	3.29 (8.22)	3.64 (7.61)	3.30 (8.44)	3.87 (9.21)	3.11 (7.43)	3.57 (8.16)
Relative pay	1.31 (11.27)	1.30 (9.37)	1.21 (10.65)	1.18 (9.67)	1.21 (9.93)	1.19 (9.36)
Unemployment	0.16 (3.44)	0.228 (4.11)	0.13 (2.94)	0.16 (3.32)	0.15 (3.15)	0.17 (3.27)
Loss of GI Bill	0.031 (0.92)	0.020 (0.49)	-0.16 (4.80)	-0.13 (3.69)	-0.16 (4.48)	-0.14 (3.82)
ETA youth	-.054 (0.81)	-.072 (0.90)	-0.080 (1.23)	-0.12 (1.78)	-0.12 (1.79)	-0.16 (2.23)
ETA countercyclical	-.084 (2.67)	-0.123 (3.27)	-0.107 (3.49)	-0.121 (3.67)	-0.125 (3.81)	-0.134 (3.89)
Navy recruiters	.33 (4.96)	0.37 (4.61)	0.29 (4.44)	0.30 (4.31)	0.34 (4.94)	0.35 (4.83)
Army recruiters	0.13 (1.26)	0.27 (2.12)	0.21 (2.03)	.24 (2.19)	0.23 (2.06)	0.25 (2.17)
Air Force recruiters	0.37 (4.18)	0.50 (4.80)	0.44 (5.17)	.58 (6.28)	0.48 (5.21)	0.59 (6.13)

TABLE 12 (Cont'd)

Explanatory variable	All HSGs		1-3A-HSGs		1-2 HSGs	
	Total	Whites	Total	Whites	Total	Whites
Marine Corps recruiters	0.12 (1.69)	-.0079 (.095)	0.22 (3.23)	.14 (1.99)	0.28 (3.88)	0.22 (2.93)
Percent black population	.0098 (6.58)	- -	-0.0054 (3.71)	- -	-0.0083 (5.32)	- -
Total (or white) population	.084 (2.08)	.083 (1.72)	0.16 (4.15)	.13 (3.01)	0.20 (4.72)	0.17 (3.88)
R^2	0.68	0.67	0.78	0.75	0.80	0.76
Regression F	38.74	36.83	67.02	56.12	76.1	518.15
Pooling F	0.85 (43,160)	0.68 (39,165)	1.32 (43,160)	1.38 (39,165)	1.42 (43,160)	1.60[b] (39,165)
SER[c]	0.15	0.18	0.14	0.16	0.15	0.16

[a]Given in parentheses are t-value for parameter estimates.
[b]Significant at .05 level, so the test for pooling is not passed.
[c]Standard error of the regression.

The Loss of GI Bill Benefits

The loss of GI Bill benefits in 1977 caused a large decline in enlistment supply, especially for the Army probably because it offers shorter enlistment terms. The loss of GI Bill benefits caused 1-3A HSGs to decline annually by 9,300 (30 percent) for the Army, 4,500 (12 percent) for the Navy, 3,600 (10 percent) for the Air Force, and 2,100 (15 percent) for the Marine Corps. Thus, the loss of GI Bill benefits caused 1-3A HSGs to decline annually by 19,500 (16 percent) DoD-wide in FY 1977-80.

Black Population

As expected, black population has a negative effect on the enlistment supply of 1-3A HSGs, although it is associated with increases in the supply of all HSGs. This latter phenomenon may reflect an economic opportunity factor that would be picked up with better data on minorities.

Recruiters, ETA Programs and Population

Because of collinearity among recruiters, ETA programs and population, their separate effects are difficult to measure. Districts having more population have more recruiters and ETA expenditures. A doubling of all recruiters, ETA programs, and population results in slightly more than a doubling of enlistments. (The combined effect reduces to $1 + a_9$.) Regression techniques try to sort out the contributions of each factor on supply, but collinearity makes the individual effects more uncertain than implied by their t-values.*

Apparently ETA progams have only a small negative effect on enlistment supply. The size of the effect, degree of statistical significance and type of program that was most damaging, youth or countercyclical, vary by service. These low estimates still indicate that the ETA programs diverted some 1-3A HSGs from the military.

We found that a service's recruiters increase its enlistments and the supply for DoD as a whole: the elasticities range between 0.30 and 0.88, averaging 0.52. Other services' recruiters also appear to increase enlistments, but the magnitude of the cross effects seem too large. For example, for Navy 1-3A HSGs the elasticity of Air Force recruiters (0.56) is greater than the elasticity of Navy recruiters

* See Maddala [22], p. 187. We suspect the collinearity among variables would tend to mingle their effects: it would tend to lower the negative ETA elasticities toward zero, lower own service and raise other service recruiter elasticities, and lower population elasticities. The specific estimates of these factors seem to reflect these sorts of effects.

(0.46). The magnitude of cross effects makes us strongly suspect that the results are caused by collinearity.

The elasticities of population implied by the regression results are given in table 13. The estimates are low, averaging 0.14. They range from an implausible -0.086 for the Marine Corps, to 0.36 for the Army. Here again we suspect the results are caused by collinearity. While earlier cross section studies also found population elasticities that are considerably less than 1.0, their results also may be due to collinearity between recruiters and population.

TABLE 13

ESTIMATES OF POPULATION ELASTICITIES[a]

Service	All HSGs	1-3A HSG	1-2 HSGs
Navy	0.18	0.13	.084
Army	0.48	0.36	0.28
Air Force	0.19	0.17	0.07
Marine Corps	-.014	-0.086	-0.11
Average	0.21	0.14	0.08

[a]The population elasticity, a_{12}, is equal to $1 + a_9 - (a_3 + a_4 + \ldots + a_8)$. Note that t-values for population elasticities with respect to 1-3A HSGs are given in table F-1.

Source: Tables 8-11.

THE ENTANGLEMENT OF RECRUITER AND POPULATION EFFECTS: A PREDICTIVE TEST

The results regarding other services' recruiters seem so implausible that they are almost surely caused by collinearity. As a result, we have dropped other services' recruiters and reestimated the models for all races combined (see tables 14-17).

We now estimate higher elasticities for own service recruiters (an average of 0.80) and population (an average of .39). While the population elasticities are more plausible, they are still considerably less

TABLE 14

NAVY ENLISTMENT SUPPLY MODELS[a]

Explanatory variable	All HSGs	1-3A HSGs	1-2 HSGs
Constant	-0.22 (0.65)[b]	-0.57 (1.47)	-0.92 (2.31)
Relative pay[d]	0.87 (6.88)	0.93 (6.55)	0.89 (5.96)
Unemployment[d]	0.35 (6.46)	0.29 (4.85)	0.28 (4.44)
Loss of G.I. Bill	-0.035 (0.93)	-0.15 (3.70)	-0.15 (3.41)
ETA youth[d]	0.076 (1.06)	0.039 (0.49)	0.0029 (0.034)
ETA countercyclical[d]	-0.091 (2.49)	-0.086 (2.12)	-0.092 (2.14)
Navy recruiters[d]	0.66 (9.73)	0.74 (9.72)	0.80 (9.97)
Percent Black population	0.0023 (1.64)	-0.0062 (4.04)	-0.0087 (5.34)
Total population[d]	0.084 (1.86)	0.12 (2.29)	0.144 (2.73)
R^2	0.60	0.63	0.63
SER[c]	0.17	0.19	0.20

[a]Differs from table 8 by excluding other services' recruiters.
[b]t-test value of statistical significance different from zero.
[c]Standard error of the regression.
[d]Natural logarithms.

TABLE 15

ARMY ENLISTMENT SUPPLY MODELS[a]

Explanatory variable	All HSGs	1-3A HSGs	1-2 HSGs
Constant	2.64 (6.24)[b]	1.68 (4.12)	1.29 (3.07)
Relative pay	2.14 (12.48)	2.22 (13.51)	2.16 (12.72)
Unemployment	0.073 (1.06)	-0.061 (0.92)	-0.02 (0.30)
Loss of G.I. Bill	-0.011 (0.22)	-0.30 (6.31)	-0.31 (6.47)
ETA youth	-0.074 (0.81)	-0.0016 (0.02)	0.023 (0.25)
ETA countercyclical	0.021 (0.44)	-0.035 (0.78)	-0.073 (1.57)
Army recruiters	0.38 (3.14)	0.72 (6.19)	0.84 (6.98)
Percent Black population	0.017 (7.43)	-0.012 (5.41)	-0.017 (7.64)
Total population	-0.12 (2.12)	0.076 (1.45)	0.99 (1.82)
R^2	0.66	0.71	0.75
SER[c]	0.22	0.21	0.22

[a]Differs from table 9 by excluding other services' recruiters.
[b]T-test value.
[c]Standard error of the regression.

TABLE 16

AIR FORCE ENLISTMENT SUPPLY MODELS[a]

Explanatory variable	All HSGs	1-3A HSGs	1-2 HSGs
Constant	2.60 (6.95)[b]	2.51 (6.24)	2.33 (5.44)
Relative pay	1.03 (7.96)	0.98 (7.03)	1.00 (6.75)
Unemployment	0.13 (2.51)	0.15 (2.68)	0.19 (3.16)
Loss of G.I. Bill	0.062 (1.61)	-0.11 (2.60)	-0.12 (2.75)
ETA youth	0.0041 (0.053)	-0.046 (0.56)	-0.081 (0.92)
ETA countercyclical	-0.074 (1.72)	-0.069 (1.51)	-0.089 (1.83)
Air Force recruiters	0.69 (8.03)	0.72 (7.90)	0.84 (8.6)
Percent Black population	-0.0019 (1.26)	-0.0088 (5.47)	-0.012 (7.24)
Total population	0.045 (0.95)	0.08 (1.57)	0.12 (2.15)
1980 DEP policy change	0.22 (5.66)	0.13 (3.19)	0.12 2.60)
R^2	0.61	0.65	0.69
SER[c]	0.17	0.18	0.20

[a]Differs from table 10 by excluding other services' recruiters.
[b]T-test value.
[c]Standard error of the regression.

TABLE 17

MARINE CORPS ENLISTMENT SUPPLY MODELS[a]

Explanatory variable	All HSGs	1-3A HSGs	1-2 HSGs
Constant	1.76 (3.68)[b]	2.08 (4.16)	1.99 (3.84)
Relative pay	0.29 (1.73)	0.38 (2.14)	0.42 (2.31)
Unemployment	0.29 (4.09)	0.26 (3.57)	0.27 (3.53)
Loss of G.I. Bill	0.10 (2.02)	-0.16 (2.96)	-0.16 (2.95)
ETA youth	0.063 (0.66)	0.027 (0.27)	-0.017 (0.16)
ETA countercyclical	-0.13 (2.82)	-0.20 (3.93)	-0.23 (4.40)
Marine Corps recruiters	0.80 (8.72)	1.009 (10.52)	1.08 (10.92)
Percent Black population	0.0025 (1.31)	-0.015 (7.60)	-0.019 (8.91)
Total population	0.055 (0.98)	0.11 (1.86)	0.14 (2.26)
R^2	0.39	0.70	0.73
SER[c]	0.23	0.24	0.25

[a]Differs from table 11 by excluding other services' recruiters.
[b]T-test value.
[c]Standard error of the regression.

than 1.0 (see table 18). Without own service recruiters in the model the population elasticities are much closer to 1.0. For 1-3A HSGs, the results are 1.05 for the Army, 0.91 for the Navy, 0.80 for the Air Force, and 0.94 for the Marine Corps.*

TABLE 18

ESTIMATES OF POPULATION ELASTICITIES[a]

Service	All HSGs	1-3A HSG	1-2 HSGs
Navy	0.43	0.42	0.43
Army	0.55	0.39	0.31
Air Force	0.43	0.47	0.45
Marine Corps	0.33	0.27	0.30
Average	0.44	0.39	0.37

[a]The population elasticity, a_{12}, is equal to $1 + a_9 - (a_3 + a_4 + \ldots + a_8)$. Note that t-values for population elasticities with respect to 1-3A HSGs are given in table F-2.

Source: Tables 14, 15, 16, and 17.

If recruiters are simply picking up the effect of population, a model with recruiters would forecast poorly over a period in which recruiters increase sharply, e.g., FY 1980. In other words, if the true effect of recruiters is really zero, a model with recruiters would forecast poorly compared with one that excludes recruiters. As a check on the elasticities of recruiters and population, we undertook a forecasting test in FY 1980 with 1-3A HSG models that include and exclude own service's recruiters. In fact, the models with recruiters forecast

* Obtained by estimating equation 1 without recruiters (of any service).

more accurately: -8.1 versus -15.5 percent error (see table 19).* This evidence demonstrates that recruiters affect enlistments, and that population elasticities are considerably less than 1.0. These findings regarding the effect of population indicate that population may have a smaller effect than many people thought. If nothing else changed, population declines in the 1980s would cause supply to fall by less than eight percent.**

TABLE 19

FORECASTING TEST IN FY 1980

Service	Actual number 1-3A HSGs	Forecasts: With own service recruiters	Forecasts: Without recruiters
Army	26,600	25,600 (-3.8)	25,200 (-5.3)
Navy	39,000	35,300 (-9.5)	32,700 (-16.2)
Air Force	40,300	35,300 (-12.4)	30,700 (-23.8)
Marine Corps	14,500	13,700 (-5.5)	13,100 (-9.7)
DoD	120,400	109,900 (-8.1)	101,700 (-15.5)

[a]Percent error given in parentheses: (forecast-actual) ÷ actual

* The forecasting test also shows that all the models underestimate supply, especially for the Air Force. We suspect this occurred because unemployment and ETA elasticities are biased downward, and the Air Force changed recruiting policies in FY 1980. Another reason for underestimations is that in the middle of FY 1979 there was a change in the definition of "high school diploma graduates". OSD started counting those having 12 years of school and a certificate of attendance as a high school diploma graduate. The change affected the Army and Marine Corps much more than the Navy and Air Force (see table 20). Taking this change in definition into account, the forecast error of the model is less than one percent for Army and Marine Corps, and about seven percent for DoD.

** Estimated by multiplying the average of the population elasticities (0.39) by the expected percentage decline in population FY 1980 to FY 1990 (18 percent).

TABLE 20

CERTIFICATE HOLDERS WHO ATTENDED SCHOOL FOR 12 YEARS

	FY 1979				FY 1980				FY 1981			
Service	I-II	IIIA	IIIB	Total	I-II	IIIA	IIIB	Total	I-II	IIIA	IIIB	Total
Navy	198	142	253	972	126	86	160	597	37	26	27	116
Army	106	131	226	1,501	351	411	705	4.050	544	614	1,313	5,428
Air Force	26	8	16	56	15	0	1	16	10	2	1	13
Marine Corps	253	279	532	1,955	400	414	681	2,706	383	381	858	1,950

Source: DMDC

Variables that have thus far been excluded from the analysis could be causing an overestimation of the effect of additional recruiters and an underestimation of the effect of shrinking population. In particular, factors that affect the way recruiters are allocated and managed and motivated have not been addressed. An analysis of two such factors was performed, with reassuring results.

Recruiters are assigned more intensively to urban areas. If urban youths are more likely to enlist than their rural counterparts, the coefficient for recruiters may exaggerate their true effect. To check this possibility, an urbanization variable was added to the analysis. It showed that recruiting is indeed better in urban areas. Coefficients for recruiters and population were, however, barely affected by the inclusion of the additional variable.

One tool the services employ in the management of their recruiters is the assignment of quotas or goals. Every recruiter is responsible for attracting a specified number of high quality recruits. This poses a problem for analysis of the effect of recruiters on accessions. How much of the apparent impact of extra recruiters is really the result of higher quotas? Could we raise accessions by increasing quotas without fielding additional recruiters?

An auxiliary analysis was performed to examine the seriousness of these concerns. Goals per recruiter was included as an additional independent variable. The purpose of this was to disentangle the effect of raising goals from the effect of raising recruiters. Goals per recruiter entered significantly but its effect was to raise the coefficient of the recruiter variable and shrink the apparent effect of population changes.

A forecasting test was performed. The model with goals per recruiter was estimated using data through FY 1979 and predictions were made for FY 1980. This test is of particular interest because recruiters rose in FY 1980 while total goals remained basically unchanged. The model without goals per recruiter predicted the sharp upturn in contracts. The modified model did not. From the points of view of both conservatism and predictive success, it seems preferable to exclude goals from further consideration in this paper. More research into the setting of quotas and the allocation of recruiters may, however, be fruitful.

COST-EFFECTIVENESS OF GI BILL, PAY, RECRUITERS, AND NAVY ADVERTISING

Although the loss of GI Bill benefits in 1977 caused a large decline in enlistment supply, a GI Bill is an expensive way of increasing supply compared with bonuses, recruiters or advertising (see table 21). OSD estimates that a GI Bill similar to the previous one would cost two to three billion dollars per year in steady state over the cost of VEAP.

TABLE 21

MARGINAL COST PER 1-3A HSG IN FY 1979[a]
(in FY 1979 dollars)

	Navy	Army	Air Force	Marine Corps
GI Bill[b]	200,000	200,000	200,000	200,000
2,500 bonus[c]	29,400 (2,613)[d]	13,800 (5,106)	28,000 (2,813)	68,300 (395)
Own service recruiters[e]	5,800 (6.0)	9,200 (3.8)	2,800 (12.6)	6,600 (5.3)
Navy advertising	1,600[f]	N.A.[g]	N.A.	N.A.

[a]Evaluated using marginal productivities and costs in FY 1979.
[b]Calculated by use of OSD's estimate that a GI Bill would cost $2 billion over the cost of VEAP. Cost per 1-3A HSG for each service assumed equal to cost per 1-3A HSG estimated for DoD as a whole.
[c]Assumes a $2,500 bonus increases an enlistee's discounted military earnings by ten percent over a 4-year enlistment.
[d]Marginal productivities given in parentheses.
[e]Assumes the marginal cost of fielding a recruiter is $35,000.
[f]Average of marginal costs for print advertising ($700) and broadcast advertising ($2,400). For details, see appendix E.
[g]N.A. = Not available due to lack of data

Taking retention effects into account,* it would generate about 10,000 additional 1-3A HSGs for DoD, at a marginal cost that would probably exceed $200,000 ($2 billion cost divided by 10,000 enlistees). The cost of using enlistment bonuses would be much less--$13,800 to $68,300. However, for moderate expansions of supply, both of these alternatives are expensive compared to recruiters, whose costs are $2,800 to $9,200.

Appendix E uses regression analysis to analyze two types of Navy advertising--"broadcast" and "print". The results indicate that Navy advertising is the least costly way of generating Navy enlistments: the cost per additional 1-3A HSG would have been $1,600, i.e., the average of costs for print ($700) and broadcast advertising ($2,400). These costs are substantially below those of the other alternatives--even recruiters. However, advertising has a small effect, i.e., elasticities of .03-.06, and the productivity of advertising falls quickly. As a result, advertising can be used to generate only small increases in enlistment supply. Still, some increases in advertising relative to recruiters appear to be justified.

WHY THERE WERE SHORTFALLS IN FY 1978-79

The serious recruiting shortfalls of the late 1970s occurred primarily because of government policies: cuts in GI Bill benefits, caps on military pay, and increases in ETA programs. The effects of various policies upon enlistments are quantified in table 22. These policy changes reduced the enlistment supply of 1-3A HSGs in FY 1976T-78 by 53 percent for the Army and 28 to 38 percent for the other services. The differences between predicted and actual changes are due to changes in other factors as well as prediction error.

* The GI Bill also reduced retention of career military personnel, who had to leave the service to collect GI Bill benefits. Preliminary analysis by OSD indicates the retention losses were about half of the increase in first-term supply. Thus, the net gain in manpower due to the old GI Bill was only about 10,000 per year.

TABLE 22

PERCENTAGE DECLINES OF 1-3A HSGs IN FY 1976T-78
CAUSED BY CHANGES IN GOVERNMENT POLICIES

	Percent change			
Supply variables	Navy	Army	Air Force	Marine Corps
Loss of GI Bill	-15.0	-30.0	-11.0	-16.0
Relative military pay	-8.4	-20.0	-8.8	-3.4
ETA youth	1.0	-.04	-1.2	.70
ETA countercyclical	-8.3	-3.36	-6.62	-19.2
Total predicted	-30.7	-53.4	-27.6	-37.9
Actual decrease	-31.1	-43.0	-26.5	-30.9

SUPPLY AND DEMAND IN THE 1980s

FORECASTS OF SUPPLY

In using our results to forecast enlistment supply in the 1980s, we assume that changes in supply factors occur uniformly across Navy recruiting districts, (e.g., if unemployment increases by 10 percent nationally, it increases by 10 percent in each district). Thus, we can use the following service-wide forecasting equation:

$$H_t^f = H^p_{1980}\left(1 + \sum_i \varepsilon_i \%\Delta x_i\right) \qquad (3)$$

H^p_{1980} is the predicted aggregate level of supply in FY 1980, obtained by summing predictions for the districts. These aggregate predictions are based on the estimates of the models obtained with five years of data. The ε_i are elasticities of supply factors given previously in tables 14-17.

Exogenous Variable Forecasts

The percentage changes in the supply factors, $\%\Delta x_i$, relative to FY 1980 levels, are given in table 23. Over FY 1981-1982, we estimate relative military pay to have increased by 9.3 percent. We assume that after FY 1982 military pay will increase at the same rate as civilian pay.

Unemployment increased by 13 percent in FY 1981, i.e., from 6.7 to 7.6 percent. In FY 1982, we estimate it will average about nine percent, an increase of 34 percent over FY 1980.* We assume that employment will fall to 7.6 percent in FY 1983 and that in FY 1983-1987 it is again 6.7 percent (its average long-run level in FY 1973-1980).

For now, we assume there is no GI Bill for any of the services. The Reagan Administration has been cutting ETA programs drastically. After FY 1980 ETA youth programs declined by 25.5 percent and countercyclical ETA programs declined by 94.6 percent. We assume these lower funding levels continue in FY 1983-1987. For recruiters, we use preliminary estimates of the actual numbers on board in FY 1982 (from DMDC) as our forecast for FY 1983-1987. Population will trend downward starting in FY 1982. We estimated the magnitude of the downward trend with data from Current Population Surveys.

* Estimate based on seven months of data from the Bureau of Labor Statistics.

TABLE 23

PERCENT CHANGES IN SUPPLY FACTORS RELATIVE TO 1980 LEVELS

Fiscal year	Relative military pay	Unemployment	ETA		Recruiters				Population
			Youth	Countercyclical	Navy	Army	Air Force	Marine Corps	
1981	6.2	13	13.7	-38.6	1.0	4.2	6.6	0	0
1982	9.3	34	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-2.0
1983	9.3	13	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-4.3
1984	9.3	0	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-7.6
1985	9.3	0	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-11.1
1986	9.3	0	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-13.9
1987	9.3	0	-25.5	-94.6	-5.5	13.6	-2.6	-4.5	-15.6

Enlistment Forecasts

Forecasts for FY 1981-87 for each service are given in table 24 together with actual enlistments excluding certificate holders in FY 1980 and FY 1981. The model predicts increases in FY 1981 and these did indeed occur. However, it predicts a little high for all HSGs and little low for HSGs in the upper mental groups. Nevertheless, the model has predicted reasonably well for two years in a row.

Relative to FY 1980, the average annual increase in the supply of 1-3A HSGs is predicted to be 5 to 32 percent for the services and 14.8 percent for DoD as a whole (see table 25). Enlistments should peak in FY 1982 and decline thereafter because of declines in population and unemployment.

In the following sections we compare forecasts of enlistments with recruiting goals to determine whether the services are likely to experience shortfalls in the 1980s.

RECRUITING GOALS: THE NEED FOR 1-3 HSDGs

The services have recruiting goals for the quantity and quality of NPS male enlistments. The goals are as follows:

Quantity Goal

1. The total number of NPS male enlistments (E) is equal to a total target.

Quality Goals

2. High school diploma graduates (HSDGs) as a percent of total enlistments be greater than or equal to p_1.

3. Mental group 1-3As as a percent of total enlistments be greater than p_2.

4. Mental group 4 enlistments (who are required to be HSDGs) as a percent of total enlistments be less than or equal to p_3.

Because there is an excess supply of non-high school graduates and mental group 4 HSDGs, we can assume that the third and fourth goals are just achieved. This enables us to reduce the four goals to one in terms MG 1-3 HSDGs and total enlistments (E):

$$\text{HSDG/E} - (\text{MG4 HSDG})/\text{E} = (\text{MG1-3 HSDG})/\text{E} \geq p_1 - p_3$$

TABLE 24

FORECASTS OF HSG ENLISTMENT SUPPLY FY 1981-87 (THOUSANDS)

Service	HSGs	Actuals[a] 1980	Actuals[a] 1981	Forecast 1981	1981 forecast error (%)	Forecasts 1982	1983	1984	1985	1986	1987
Navy	All	66.9	73.1	74.1	1.4	78.6	73.2	69.4	68.4	67.6	67.1
	1-3A	38.9	43.9	42.3	-3.6	44.7	42.1	40.2	39.6	39.2	38.9
	1-2	26.4	29.1	28.5	-2.1	30.5	28.7	27.5	27.1	26.8	26.6
Army	All	70.0	80.2	80.5	+0.4	88.2	87.3	86.0	84.6	83.5	82.8
	1-3A	25.8	35.3	30.9	-12.5	34.8	34.6	34.3	33.9	33.6	33.4
	1-2	16.8	22.6	20.1	-11.1	23.0	22.9	22.7	22.5	22.4	22.3
Air Force	All	68.0	71.5	78.4	9.7	80.3	77.7	75.7	74.7	73.8	73.4
	1-3A	40.3	47.2	46.2	-2.1	48.0	46.3	44.8	44.2	43.7	43.3
	1-2	25.2	29.6	29.3	-1.0	31.0	29.7	28.7	28.4	28.0	27.8
Marine Corps	All	29.2	30.5	33.6	10.2	36.0	33.9	32.4	32.1	31.8	31.6
	1-3A	13.7	18.0	15.9	-11.7	17.5	16.7	16.1	15.9	15.8	15.8
	1-2	8.6	10.9	9.8	-10.1	11.1	10.6	10.2	10.1	10.0	10.0

[a]Excludes certificate holders.

The percent of total enlistments accounted for by mental group 1-3 HSDGs must be greater than $p_1 - p_3$.

TABLE 25

FORECASTS OF THE PERCENT CHANGE IN
SUPPLY OF 1-3A HSGs COMPARED TO THE NUMBER RECRUITED IN FY 1980

	1982	1983	1984	1985	1986	1987	Average 1982-1987
Navy	14.9	8.2	3.3	1.8	0.77	0	4.8
Army	34.9	34.1	32.9	31.4	30.2	29.5	32.2
Air Force	19.1	14.9	11.2	9.7	8.4	7.4	11.8
Marine Corps	27.7	21.9	17.5	16.1	15.3	15.3	19.0
DoD	22.2	17.7	14.1	12.6	11.5	10.7	14.8

Source: Table 24

The p_1 and p_3 recruiting goals for each service are given in table 26 for FY 1982-87. Note that the Army's goal for percent 1-3 HSDGs (p_1-p_3) is increasing sharply in comparison with what was achieved in FY 1980. For the other services, it is about the same in FY 1982-87 as that achieved in FY 1980.

Goals for all NPS males (E) and the total number of 1-3 HSDGs, i.e., (p_1-p_3) x E are given in table 27 for FY 1982-87; the number of 1-3 HSDGs achieved in FY 1980 and FY 1981 are also given for comparison. Certificate holders are included in the service's enlistment goals but our forecasts essentially exclude them. To make the analyses consistent, we have reduced the goals for 1-3 HSDGs by the number of certificate holders recruited in FY 1981. Thus both supply forecasts and enlistment goals will exclude certificate holders.

The Army's goal for 1-3 HSDGs in FY 1983-87 is about 10 percent greater than the number recruited in FY 1981. For the other services, goals for 1-3 HSDGs are below those actually achieved in FY 1981. The next sections address the question of whether the services will achieve their goals in FY 1982-87.

TABLE 26

PERCENTAGE 1-3 HSDG RECRUITING QUALITY GOALS FOR FY 1982-87

	Percent HSDGs (p_1)	Percent category 4s (p_3)	Percent 1-3 HSDGs (p_1-p_3)
Army[a]	65	20	45 (26.2)[b]
Navy	72	13	59 (57.4)
Marine Corps	75	10	65 (63.8)
Air Force	85	10	75 (71.6)

[a]For FY 1982 the Army's target for MG4 HSDGs/E is 25 percent. For FY 1983-87 it is 20 percent. Thus, $p_1 - p_3$ is 40 percent in FY 1982 and 45 percent in FY 1983-87.
[b]FY 1980 value of $p_1 - p_3$ given in parentheses.

METHOD OF FORECASTING THE SUPPLY OF 1-3 HSDGs

To determine whether the goals for 1-3 HSDGs will be achieved, we must forecast the supply of 1-3 HSDGs. We do this by converting the forecast of all HSGs (given previously in table 24) to a forecast of 1-3 HSDGs:

$$1\text{-}3\ \text{HSDG}^f = C\ \text{HSG}^f,$$

where for each service, C is the average fraction of all HSGs in FY 1976T-80 that were 1-3 HSDGs (see table 28).

SUPPLY AND DEMAND FOR FY 1982-87

Recruiting goals and forecasts of supply are given in table 29. In FY 1982-87, the Air Force, and Navy should achieve their enlistment goals by a comfortable margin. The Marine Corps should also achieve its goals, with the possible exception of 1985 when a slight shortfall is forecast. However, unlike the Navy and Air Force, Marine Corps enlistment supply is only slightly greater than goals for most of the 1980s.

TABLE 27

DERIVATION OF RECRUITING GOALS FOR 1-3 HSDGs IN FY 1982-87

Service	Actual 1-3 HSDGs[a] 1980	1981	Category	1982	1983	1984	1985	1986	1987
Army	33.3	49.6	NPS Males	127.0	127.0	127.0	127.0	127.0	127.0
			MG 1-3 HSDG (45%)[b]	50.8	57.2	57.2	57.2	57.2	57.2
			certicate holders 1981	2.5	2.5	2.5	2.5	2.5	2.5
			goal for 1-3 HSDGs	48.3	54.7	54.7	54.7	54.7	54.7
Navy	44.6	51.8	NPS Males	80.0	78.9	76.1	80.5	71.1	69.8
			MG 1-3 HSDG (59%)	47.2	46.6	44.9	47.5	41.9	41.2
			certificate holders 1981	0.1	0.1	0.1	0.1	0.1	0.1
			goal for 1-3 HSDG (65%)	47.1	46.5	44.8	47.4	41.8	41.1
Marine Corps	22.7	25.4	NPS Males	37.0	37.0	37.0	37.0	36.5	36.0
			MG 1-3 HSDG (65%)	24.1	24.1	24.1	24.1	23.7	23.4
			certificate holders 1981	1.6	1.6	1.6	1.6	1.6	1.6
			goal for 1-3 HSDG	22.5	22.5	22.5	22.5	22.1	21.8
Air Force	49.1	59.8	NPS Males	71.6	70.8	70.8	70.8	71.8	70.8
			MG 1-3 HSDG (75%)	53.7	53.1	53.1	53.1	53.9	53.1
			certificate holders 1981	0[c]	0	0	0	0	0
			goals for 1-3 HSDG	53.7	53.1	53.1	53.1	53.9	53.1

[a]Excludes certificate holders.
[b]Target for MG 1-3 HSDGs including certificate holders, as a percent of NPS male accessions. Target for Army is 40% in 1982.
[c]Less than 50.

TABLE 28

1-3 HSDGs AS A PERCENT OF ALL HSGs IN FY 1976T-80

Navy	72
Army	54
Air Force	82
Marine Corps	71

Source: DMDC

Given our assumptions, for the Army we forecast increasing shortfalls averaging 13.8 percent in the 1980s (see table 30). However, for two reasons, these forecasts are low. First, the model forecasts too low in FY 1981, 6,000 fewer than the number recruited. This is probably because the effect of unemployment is biased downward for the Army.

Second, GI Bill benefits for Army enlistees were increased sharply in FY 1982 with the expansion of the "Ultra VEAP" program. It is difficult to forecast the effects of Ultra VEAP. Our study estimated that the effect of the loss of the old GI Bill was a 30 percent decline in supply, but there are major differences between the old GI Bill and Ultra VEAP. Ultra VEAP requires contributions on the part of enlistees.* On the other hand, only Army enlistees are eligible, which might result in "cross overs" by those who would have joined the other services.

Because of the reduced eligibility, we estimate that Ultra VEAP will perhaps increase Army enlistment supply by 20 percent, If it does, the Army will achieve its goals. If Ultra VEAP does not so increase supply, the Army may need modest increases in recruiting resources.

* Only 1-3 HSDGs are eligible for benefits. In FY 1981 they constituted about 65 percent of HSGs.

TABLE 29

GOALS AND SUPPLY OF 1-3 HSDGs (000) IN FY 1982-87

Service	Actual 1-3 HSDGs[a] 1980	1981	Category	1982	1983	1984	1985	1986	1987
Army			Goals	48.3	54.7	54.7	54.7	54.7	54.7
	33.3	49.6	Supply	47.6	47.1	46.4	45.7	45.1	44.7
		(43.5)[b]	Shortfalls	.7	7.6	8.3	9.0	9.6	10.0
Marine Corps			Goals	22.5	22.5	22.5	22.5	22.1	21.8
	22.7	25.4	Supply	25.6	24.1	23.0	22.3	22.6	22.4
		(23.8)	Shortfalls	-	-	-	0.2	-	-
Navy			Goals	47.1	46.5	44.8	47.4	41.8	41.1
	44.6	51.8	Supply	56.6	52.7	50.0	49.2	48.7	48.3
		(53.3)	Shortfalls	-	-	-	-	-	-
Air Force			Goals	53.7	53.1	53.1	53.1	53.9	53.1
	49.1	59.8	Supply	65.8	63.7	62.1	61.3	60.1	60.2
		(64.3)	Shortfalls	-	-	-	-	-	-

[a]Preliminary estimates.
[b]Forecasts of 1-3 HSDGs in FY 1981 given in parentheses.

TABLE 30

PERCENTAGE SHORTFALLS OF 1-3 HSDGs IN FY 1982-87

Service	1982	1983	1984	1985	1986	1987	Average 1982-87
Army shortfalls (%)	1.4	13.9	15.2	16.5	17.6	18.3	13.8
Marine Corps	none	none	none	1.0	none	none	none
Navy	none	none	none	none	none	none	none
Air Force	none	none	none	none	none	none	none

Source: Table 29.

CONCLUDING COMMENTS

This study sheds a great deal of light on enlistment supply issues. By and large, it provides plausible estimates of the effects of supply factors, e.g., pay, GI Bill benefits, recruiters, advertising, and population. These estimates provide important information for planning and policy development.

However, some estimates do not seem plausible. The least plausible are the small effects of unemployment, especially on the Army. A fluctuation of the economy in 1976-80 was a major cause of a fluctuation in recruiting. Yet too little of the fluctuation in enlistments seems to be attributed to changes in unemployment per se.

In some cases the pattern of findings seems inconsistent. Why is the pay elasticity so much higher for the Army than the other services? Why is the population elasticity so much lower for the Marine Corps?

The answers may be in the analysis of the two factors not considered in the study--standards and policies. These factors are used by the services to control the flow of enlistments--to balance supply and demand. Changes in weight standards by the Air Force contributed to the upturn in that service's enlistments in 1980. Changes in recruiting policies may have caused the unexplained increase in Marine Corps enlistments in 1980 and 1981. We suspect that without these factors in the model, there will be cases in which enlistments are not forecast accurately.

The approach of using annual time series cross-section data seems to be a fruitful one. To make it more useful for forecasting and policy analysis, more research is needed on unemployment, standards, and policies.

REFERENCES

[1] Altman, S.H., "Earnings, Unemployment and the Supply of Enlisted Volunteers," Journal of Human Resources, IV-1 (1969), pp. 38-59

[2] Amey, D.M., et al., "Econometric Models of Armed Forces Enlistment Levels," OAD-CR-160, General Research Corporation, Oct 1976

[3] Borack, J., and Siegel, B.S. "An Econometric Model of Navy Enlistment Behavior," TN-81-16, Navy Personnel Research and Development Center, Jan 1981.

[4] Cook, A.A. "Supply of Air Force Volunteers," The Report of the Presidential Commission on an All Volunteere Force, TT-4-1, Washington D.C., U.S. Government Printing Office, Nov 1970

[5] Cooper, Richard V.L., "Military Manpower and The All-Volunteer Force, Rand Coporation Paper No. R-1450-ARPA, Sep 1977

[6] Cralley, W.E., "The Impact of Youth Unemployment Rate and the Expiration of the GI-Bill on Marine Corps Enlistments," Memo 81-3020.10, Center for Naval Analyses, Oct 1981

[7] Cralley, W.E. "The Supply of Marine Corps Recruits-A Micro Approach," CNS 1117, Sep 1979

[8] Fechter, A.E., "Impact of Pay and Draft Policies in Army Enlistment Behavior," The Report of the Presidential Commission on an All-Volunteer Force, II-3-1, Washington, D.C., U.S. Government Printing Office, Nov 1970

[9] _____, "The Supply of Enlisted Volunteers in the Post-Draft Environment: An Evaluation Based on Pre-1972 Experience," R-2396P-RPA, Rand, Dec 1978

[10] Fernandez, R.L., "Forecasting Enlisted Supply: Projections for 1979-1980," N-1297-MRAL, The Rand Corporation, Sept 1979

[11] _____, "Measuring the Effects of Policy Changes: Post Service Education Benefits," In Department of Defense and Navy Personnel Supply Models, edited by Cirie, J., Miller J.J., and Sinaiko, H.W., TR-9 Smithsonian Institution, May 1981

[12] Fisher, A.C., "The Cost of the Draft and the Cost of Ending the Draft," American Economic Review, LIX (19169), pp. 239-254

[13] Goldberg, L. "Recruiters, Advertising, and Navy Enlistments," Center for Naval Analysses, CRC 409, Nov 1979

REFERENCES (Cont'd)

[14] Goldberg, L., "An Econometric Model of the Supply of Enlistments: Estimates and Applications," Draft Report, General Research Corporation, Jun 1975

[15] Gray, B.C., "Supply of First-Term Military Enlistees," The Report of the Presidential Commission on an All-Volunteer Force, II-2-1, Washington, D.C., U.S. Government Printing Office, Nov 1970

[16] Greenston, P.M., and Toikka, R.S., "The Determinants of Navy Recruit Quality: Theory and Evidence, 1970-1977," Tech Rep V.I. No. 1168, The Urban Institute, Oct 1978

[17] Grissmer, D.W., "The Supply of Enlisted Volunteers in the Post-Draft Environment: An Analysis Based on Monthly Data, 1970-1975," R-2396-ARPA, Rand, Dec 1978

[18] Huck, Daniel, and Allen, Jerry, "Sustaining Volunteer Enlistments in the Decade Ahead: The Effects of Declining Population and Unemployment," General Research Corporation, Mclean, VA, Unclassified, Sep 1977

[19] Jehn, C., and Shughart, W.F., "Recruiters, Quotas, and the Number of Enlistments," Study 1073, Center for Naval Analyses, Dec 1976

[20] Lockman, R.F., "Success Chances of Recruits Entering the Navy," Center for Naval Analyses, CNS 1086, Unclassified, Feb 1977

[21] Looper, L.T., "Recruiting Resource and Goal Allocation Decision Model," TR-79-55, Air Force Human Resources Laboratory, Jan 1980

[22] Maddala, G.S., Econometrics, McGraw-Hill, New York, 1977

[23] Moore, D.S., et al., An Econometric Analysis of Volunteer Enlistments by Service and Cost Effectiveness Comparision of Service Incentive Programs, General Research Corporation, Oct 1974

[24] Morey, R.C., "The Impacts of Various Types of Advertising Media, Demographics, and Recruiters on Quality Enlistments -Results From Simultaneous and Heteroscedastic Models," reviewed by Frank M. Bass in Department of Defense and Navy Personnel Supply Models, edited by Cirie, J., Miller, J.J. and Sinaiko, H.W., TR-9, Smithsonian Institution, May 1981

[25] Navy Recruiting Command, "NRC Policies FY 1971-FY 1977: Extracts," Unclassified, Apr 1979 (00 201196)

[26] Saving, et al., "Air Force Enlisted Personnel Retention-Accession Model," TR-80-12, Air Force Human Resources Laboratory, Jun 1980

[27] Sims, W.H. and Truss, A.R. "A Reexamination of the Normalization of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6, 7, 6E and 7E," Center for Naval Analyses, CNS 1152, Apr 1980

[28] Wachter, Michael L., "Intermediate Swings in Labor Force Participation," Brookings Papers on Economic Activity, no. 2, 1977, 545-574

[29] Welch, Finis, "Effect of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust," Journal of Political Economy, 87, October, 1979, S65-S98

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